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Dr. Martin Fleischmann

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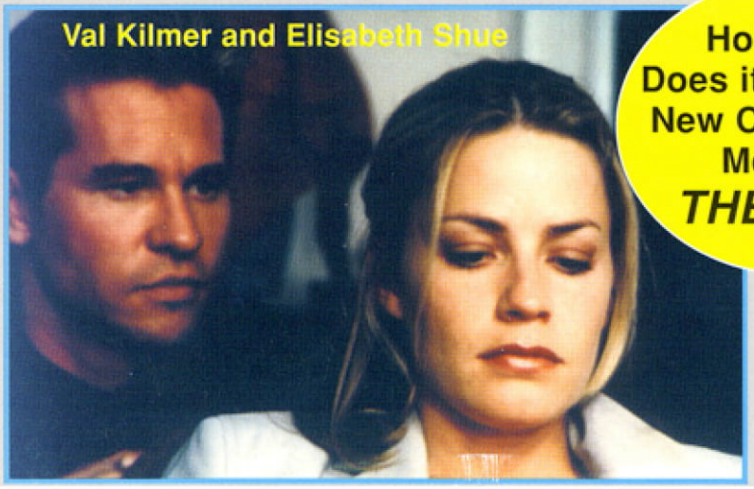

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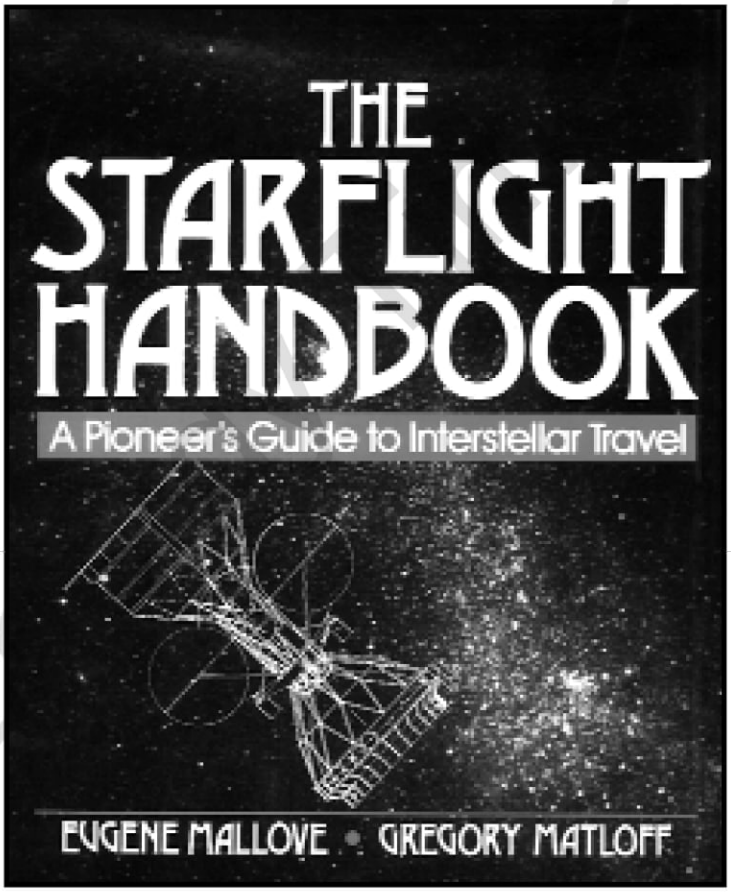

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Infinite Energy

Cold Fusion and New Energy Technology

Volume 2, No.11, Nov./Dec. 1996

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INFINITE ENERGY Magazine *(ISSN 1081-6372) is published six times a year by Cold Fusion Technology, Inc. P.O. Box 2816, Concord, New Hampshire 03302-2816. Subscription price: $29.95 U.S. and Canada, $49.95 other foreign. POSTMASTER: Send address changes to INFINITE ENERGY, P.O. Box 2816, Concord, NH 03302-2816.*

INFINITE ENERGY Magazine
P.O. Box 2816
Concord, NH 03302-2816
Phone: (603) 228-4516
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Pons, Hawkins, and Fleischmann at the University of Utah in 1989 ***(Courtesy, University of Utah)***

1997—Prof. Martin Fleischmann at home in England ***(Courtesy, the Fleischmanns)***

Val Kilmer and Elisabeth Shue star in *The Saint*, a Hollywood cold fusion movie—**March 14, 1997** ***(Courtesy, Paramount Pictures, Photo by Stephen Morley)***

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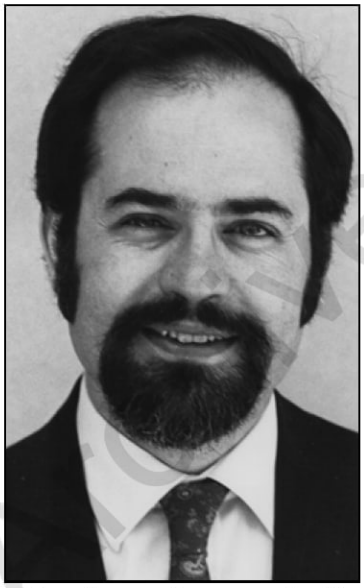
By Eugene F. Mallove, Sc.D.

Is New Physics Needed?



Most of us who were formally trained as engineers or scientists, and even non-degreed persons intensely interested in science and technology, have absorbed the idea that some very smart people have been and still are in charge of that great body of knowledge we call "Physics." Beginning with the likes of Galileo and Isaac Newton and culminating this century with Niels Bohr, Albert Einstein, and a host of other stellar physicists, physics has, indeed, managed to explain much of this world—or at least it has *seemed* to explain it. The heirs of these Great Ones, the brilliant physicists of today, must know what they are doing, right? Maybe not.

Now there appears to be a Great Awakening among many serious students of physics—a realization that perhaps "Physics" has made some pretty serious mistakes about how the world works. Maybe we need to go back and revisit some cherished assumptions of the physics establishment. After all, it is that establishment that mocks *all* evidence for cold fusion phenomena, to the extent that there is not a *single* experiment published by anyone or in any venue that can be accepted by this rigid (and corrupted) jury. If "Physics" has made such a catastrophically wrong assessment of the data for excess energy and nuclear products in low energy reactions, what *else* has it gotten wrong?

Personally, I am coming inexorably to the conclusion that it has gotten *lots* wrong in some of its most fundamental theories—from gravitation, to relativity (special and general), and from quantum mechanics to nuclear structure. The basic idea is this: success in *seeming* to explain perfectly a gigantic body of experiments, is no guarantee at all that these mathematical air-castles are not on very shaky ground—perhaps they are on no ground at all. It could require a very different physical and mathematical approach to explain the host of experimental anomalies that have emerged. Of course, the knee-jerk reaction of "Physics" is that "virtually all new findings are wrong." Seriously, that's exactly what they say!

There is an interesting sociology of science here. Most of the theorists within the cold fusion community—the ones who attend the major international conferences—are outcasts from establishment physics, simply for having the audacity to theorize at all about a subject that "Physics" has deemed too heretical for polite words.

Professor Peter Hagelstein of MIT is one such theorist. He was nearly denied tenure because of cold fusion theorizing. Yet my good friend Peter is a man who thinks all is well with quantum mechanics and relativity. Just take those tools, apply them in super-sophisticated ways, and BANG! —given enough time and care, out will come the promised theory to explain cold fusion and heavy element transmutation at low energy. It hasn't happened. That doesn't mean it won't happen, but it hasn't, and it may never.

There are other theorists in cold fusion who believe similarly to Peter: take the old "tried and true" theories—relativity and quantum mechanics—and explain the various cold fusion "miracles." For example, Drs. Talbot and Scott Chubb, great people and theorists, espouse the latter view. Ditto for Prof. Yeong E. Kim at Purdue University. Each has a different theory, all based on the "tried and true"—relativity and standard quantum mechanics.

Others are getting very restless, and have been so for a long time. Read in this issue (page 66) the review by Dr. Thomas E. Phipps, Jr. of *Newtonian Electrodynamics*, authored by Drs. Peter and Neal Graneau. For that matter, read the marvelous book by the Graneaus, *Newton versus Einstein*. Unlike the former, there is not a single equation in the latter, but one takes from that marvelous book a feeling of what a gigantic scam some of the *history* of physics presented to us by our teachers has been.

As you explore the opinions of Phipps and the Graneaus, their references, their experiments, and the journal *Galilean Electrodynamics*, from which the Phipps review comes, you will learn there is a community of very serious physicists that challenges some of the most fundamental precepts of modern "Physics." Moreover, they too—even without the cold fusion heresy—have found copious experimental data that flys in the face of much of what modern "Physics" teaches. This even on such supposedly resolved matters as the forces between current elements!

The establishment no doubt views these people who challenge field theory and Einstein as merely deluded malcontents. Those more deeply involved in cold fusion than the Graneaus or Dr. Phipps are probably regarded, by that same standard, as clinically insane!

In this issue, we are very proud to present a candid interview with Prof. Martin Fleischmann. In it he opines: "There is a great bag of physics which simply will not fit into the existing paradigm." But Fleischmann admits he is "painfully conventional," when it comes to overturning the pillars of science. Yet he does believe that extending an understanding of "condensed matter physics in general and electrolyte solutions in particular, is a pre-requisite for taking our next steps in chemistry and biology."

What is "new" physics to some, may not be to others. To Hagelstein, Chubb, Kim et al, "new" means coming up with some novel—*new*—approach to applying the "tried and true." To others, it means looking deeply into the apparent accumulated rot and dogma in "Physics," which has cast in concrete much of what "Physics" thinks it knows about the world—such as, "cold fusion is impossible."

Much of distrust of modern "Physics" comes not from any single analysis of relativity or quantum mechanics, but of the obvious arrogant disregard for experiment which has become the norm in physics. Those experiments that appear to challenge dogma are rigorously disbelieved—except perhaps those enchanting, occasionally anomalous high-energy physics experiments we read about that may bring down the house of cards, but which will still keep the mainstream physicists employed on other additions to the air-castle.

First and Foremost, we need to establish the *experimental facts* on which New Physics — *if, as we suspect,* it turns out to be needed—might be based. This is a daunting task. We'll leave it to our friends at *Galilean Electrodynamics* to handle the potential vast experimental and theoretical revisions to relativity.

As for cold fusion, we are well on the way to having the basic outline of the facts. The excess energy, transmutations, nuclear emissions, and altering of radioactivity are being intensely studied and the facts compiled. We need to know much more

Continued on page 4

New Energy Times Archive

about this nearly miraculous process, is quite akin, we have to admit, to the resurrection of ancient alchemy. So be it. We accept, without prejudice, that which nature offers.

We await further word from Dr. Randell Mills and colleagues at BlackLight Power Corp. on the latest experimental support for an altered picture of quantum mechanics involving "below ground state" hydrogen atoms. We have no problem imagining that *both* nuclear and electron cloud models of the atom could be fundamentally flawed in the regimes now being explored.

We also need to know a lot more about the carbon arc system—both in-air and in-water arcs, which various lines of evidence (see latest over-unity calorimetry results on page 38, which reaffirm those in *IE*#10) suggest are highly anomalous. There are interesting recent results in magnetic effects found in these carbon arcs, which we hope to report in a subsequent issue. There is the *possibility* of one or more confirmations of the iron production in such arcs.

We were all startled by the Finnish experiments with an apparent gravity shield effect above a high-temperature superconductor (reported in *IE*#9). *Business Week*, (February 17, 1997, page 97) continues the story with a witnessed replication by John Schnurer in Ohio. If this is for real—and we are in the process of checking it our ourselves— this will be New Physics, indeed! "Physics" is already mocking these experiments as the "cold fusion of NASA." More on this validation effort, possibly as soon as *IE*#12.

There are many other loose ends, dear readers, for which we apologize we have no final answers—or even intermediate answers. Sitting in our lab is the wonderful test rig of Paul Pantone—still untested due to time constraints, but we are hearing tantalizing reports from others. We will bring you those very soon, and we will test Paul's device ourselves now that we have heard about some caveats for the test protocol.

We have not had time to check back with Galtech to see how they are progressing on their motor/generator. But we are happy to present the full Aspden/Adams patent in this issue to give you an idea of how such motors might work.

Do we have any problem with the idea of sucking "free energy" out of space with a "magic" machine such as a magnetic motor, solid state device, or a bubble machine? Not after the experiments reported in a recent *Physical Review Letters* (see page 28), which confirm the existence of zero point energy beyond any doubt whatsoever. Too bad that the mainstream journalists are so obtuse about such matters that the technological implications of this finding haven't sunk in!

As the the eighth anniversary of the cold fusion announcement in Utah approaches (March 23, 1997), we can be very happy that an imaginative Hollywood production, *The Saint*, will debut on March 14th. In its fictional way, it may revive some public interest in the supremely important topic. We include some "program notes," courtesy of Paramount Pictures. Look at it this way, it will at least give the mainstream science journalists, who have been ignoring cold fusion, some reason to crack the books—maybe even get a copy of *Infinite Energy*—to find out what has been going on. But it will probably be "business as usual." They'll probably quote that notorious non-expert, Gary Taubes.

Following the recent cloning of a sheep—the "Dolly" affair, one ill-informed *Wall Street Journal* reporter, Michael Waldholz speculated half-seriously that Dolly might be a hoax (February 28, 1997, p. B1). In making comparisons with other alleged hoaxes in science, he took the obligatory cheap shot at cold fusion: "'Cold Fusion' promised a cheap, unlimited source of energy, but physicists soon said it was impossible. Eight years later, despite prodigious efforts, no one has been able to conclusively duplicate the

Continued on page 9

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LETTERS TO THE EDITOR

As a pilot, I am of course interested in the possibilities of alternative fuels for aircraft. I fly a Boeing 757 for United, and we get about 2 gallons/mile. Figured over 188 passengers, that is 94 seat miles/gallon, which is not bad for 500 mph. However, fuel is the 2nd largest cost for an airline, right behind total labor. A one-cent increase in the price of jet fuel costs United over $1,000,000 a year. If we can bring that cost down, we would certainly be able to lower fares *and* have more left over for the employee-owners.

On aircraft, of course, one of the most important aspects of the power plant is the weight relative to the power it puts out. On a Boeing 757 we burn about 50,000 lbs. of fuel coast-to- coast. We produce 40,000 lbs. of thrust from each of our 2 engines (80,000 lbs. total thrust). Some extra weight over current engines would be acceptable for long-haul flights, since it would be offset by the fuel you would have burned. However, on short haul flights a big weight penalty might override the fuel cost savings. We also have to consider the max landing weight limitations.

What kind of technologies are you aware of that could produce that kind of thrust within a reasonable weight limit. If we could produce even more thrust with a light weight system, we would be even happier. If everyone is building heavy at the moment, the power plants may be more suitable for ships and trains, but I was wondering if any technology looks promising for light weight and high thrust output.

You mentioned one cold-fusion pioneer who is planning to drive a 1hp car up to the patent office. I own a 1946 Cessna 140, a two-seat aircraft. If there is technology developed that could produce somewhere between 90-150 hp at less than about 300 lbs. weight, and in a package about the size of a small car engine, we could really do an interesting conversion. While I could not land at the Patent office, or even the White House Lawn (frowned upon), it would be fun to fly it to one of the local airports and let them try to figure it out. That would be very convincing, to fly without any gas in the tanks!

Let me know if you have any ideas or anyone who might be interested in pursuing some aviation applications. Thank you.

Don Daniels
Evergreen, CO

• — • — •

I just received my first issues. WOW! I especially like the scientific reviews *after* the main technical articles. For example, Michael Carrell's write-up of the Correa's PAGD is much more readable than the original article. All the time spent re-illustrating the graphs is well worth it from this reader's point of view. This *will* change the world.

I would love to hear theories from folks like Hagelstein about the source of energy. I hope this scales up easily.

The historical perspective articles are also a welcome change (Wright Brothers, etc...). What this means is that the fastest way to generate acceptance is to come out with say a $5k add-on to an electric car that simply uses one of these devices. (easier! said than done.)

Parallels with the the fuzzy logic denial by American academia are helpful here. Only two things brought about whatever level of acceptance exists today. One, the availability of fuzzy logic appliances and controllers, mostly from overseas sources, but clearly functionally superior. Two, the publication of a formal proof/derivation of fuzzy logic by an academic who "speaks the language", i.e. hot tub mathematician Bart Kosko.

The Patterson cell and AquaFuel are similarly fantastic. I would love for an investigative reporter to explain just which "bureaucratic slip-ups" enabled them to get their patents while Newman was left trying to ignite a log with a match.

The Newman machine is the only one which I can't faithfully grok right now. Yes, high-current-low-voltage appears in retrospect to be less optimal, but even the suggestion of direct matter to energy conversion of some of the copper in the windings is enough to cause me to do a triple-take.

Lastly, I'm glad I subscribed to the right magazine. Can't wait for future issues. Oh, yes. I would love an article on zero point energy and/or Puthoff. I'm not proud— it is an extremely difficult concept for me to grasp. I'm sure others are in the same boat.

Mitch Bogart
Rampage Systems, Inc.
Waltham, Massachusetts

• — • — •

Thank you for your very prompt action in respect of sending me the back-dated issues. I am glad I ordered them. The articles they contain are so interesting that it would be a shame to have missed out!

Please keep up the good work regarding Free Energy! I am a personal friend of Robert Adams and would like to advise you that friends and associates of Robert Adams have set up a Foundation.The aim of which is to provide an education and research facility for alternative energies. Robert Adams is an old man who has not profited by his research and any assistance would be appreciated.

I will keep you informed of progress and look forward to hearing from you.

Roger Zanden
New Zealand

• — • — •

Thank you for your continuing coverage of Bill Richardson's AquaFuel, D_WEnergy Research's work, and others that are probing into the secrets of this exciting new technology. I was again honored and delighted to see another one of my AquaFuel pictures published on the cover of your dynamic science journal. Thank you also for granting permission for Sarasota ECO Report to reprint the AquaFuel article in *IE* issue #9. It has generated a good response from hungry, open minds concerned about our precarious energy and pollution situation. *IE* has opened my mind to some other breakthrough technologies as well. Keep up your great work and vital service to humanity.

Rob Jaeger
Florida

• — • — •

Thanks for the prompt reply on issue

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#10! I thoroughly enjoy your magazine, tapes etc. and go through withdrawal between issues!

Bob Ludtke
Glenwood Springs, Colorado

• — • — •

Dear Mr. Rothwell,

I am a Canadian engineer. I have recently obtained Internet access and I was astonished to quickly find a multitude of reports of the so called "Cold Fusion Process."

How is this possible ? How can there possibly be cold fusion prototype machines generating kilowatts of excess energy for extended periods of time without radiation or pollution, but the world media gives no reports of any cold fusion progress ? I read science magazines, watch science and news shows, and read the news paper every day. And there's nothing about cold fusion !!!

I tell my engineer colleagues about cold fusion and they have the same initial response I had; "Impossible! Cold fusion would mean the end of global warming, the energy crisis, probably the end of pollution, poverty and profound world changes."

How is it that the media of the world has collectively missed the news story of the millennium ?

Tom Munding
CANADA

Dear Mr. Munding,

You ask:

How is it that the media of the world has collectively missed the news story of the millennium?

To make a long story short, the media usually does miss large news stories, often for years. It took the media roughly seven years (1975 - 1982) to realize that microcomputers are a revolutionary technology. It took Barry Marshall 12 years to convince the medical establishment that ulcers are caused by bacteria, not stress. He had superb clinical proof, but he was ignored or attacked the whole time. (See The New Yorker; *Sep 20, 1993.) Most major technological breakthroughs have been attacked and ridiculed. Famous examples include the phonograph, incandescent lights, and the airplane. Airplanes were attacked from 1895 to 1908. See my article in* Infinite Energy i*ssue 9. Here is my favorite quote about that subject:*

"If such sensational and tremendously important experiments are being conducted in a not very remote part of the country, on a subject in which everyone feels the most profound interest, is it possible to believe that the enterprising American reporter, who, it is well known, comes down the chimney when the door is locked in his face — even when he has to scale a fifteen-story skyscraper to do so — would not have ascertained all about them and published them broadcast long ago?

-FROM: "The Wright Aeroplane and its Fabled Performances," Scientific American, *January 13, 1906 (three years after the Kitty Hawk flight)*

You ask:

How can there possibly be cold fusion prototype machines generating kilowatts of excess energy for extended periods of time without radiation or pollution . . .

*I have no idea how it works, but the experimental result do confirm that these cells produce far less radiation than conventional fission or fusion reactors. However, they do produce x-rays and very low levels of tritium, particularly in the experiments now underway at Los Alamos. (See I*nfinite Energy *issue 7.)*

I tell my engineer colleagues about cold fusion and they have the same initial response I had; "Impossible! Cold fusion would mean the end of global warming, the energy crisis, probably the end of pollution, poverty and profound world changes."

That is correct. Cold fusion will mean the end of pollution and it will introduce profound changes. Whether it reduces poverty or not will depend upon the choices made by political leaders and voters. The fact that the technology is revolutionary and unexpected, however, has no bearing on whether it works or not. Steam engines, electricity and antibiotics were equally revolutionary and unanticipated. As Michael Faraday said, "Nothing is impossible if it be consistent with the laws of nature."

Jed Rothwell
Infinite Energy Contributing Editor

• — • — •

A subscriber sent us this copy of a letter he sent to the IEEE:

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Friends,

As a Life Member of IEEE I have a strong interest in the advice we give President Clinton or Congress. I note that we have not, to my knowledge raised objection to the recent DOE policy of opposition to research on cold fusion. DOE is not funding research on cold fusion and is threatening to cancel other kinds of contracts with groups who undertake cold fusion work. There is also a stop order preventing the US Patent Office from issuing patents on cold fusion, though a single patent was issued to Patterson before the shutdown.

The patent offices in Japan, Europe, and elsewhere are doing a landrush business. Many workers in the field report positive results and fully expect large scale commercial production in less than five years.

Cold fusion is being developed by relatively small entities with limited funding. It seems to offer an energy source with negligible pollution, small levels of radiation, low capital cost per unit of energy production, and negligible cost of materials. It also lends itself to the production of very small units suitable for automobiles and individual residences.

We at IEEE will look like fools if we don't get off the dime and back this important work. The US Magnetic and Inertial confinement experiments have cost in the billions and are unlikely to produce a practical working system for another 10 years at least. The Department of Energy should be helping to fund cold fusion. Otherwise the US is likely to be further behind other industrialized countries than it is already.

I would appreciate a response from the Board.

Sincerely,
John G. Sinclair Jr.
Life Member of IEEE
Little River, California

Bravo for that letter! We hope other IEEE members will write similar messages. We suggest, however, that neither of the hot fusion programs (magnetic or inertial), are ever likely to produce a practical working system. Long before their projected multi-billion dollar demo facilities are likely to be on line, they will be terminated by an outraged Congress. Perhaps inertial confinement fusion will continue because it can be sold as a nuclear weapons simulation project, in view of the underground nuclear test ban. —EFM

• — • — •

I received Vol. 2, No. 10 yesterday and have read several articles which generated a couple of questions and a couple of comments.

(1) Is aether related to Wilhelm Reich's orgone energy? Could aether be the missing dark matter?

(2) The crop-circle, symbol for infinity, could also be an eight (8), signifying that the human species is "caught behind the 8-ball," an old pool-hall term with obvious meaning.

In 1962, as an industrial blacksmith apprentice working in the auto industry, I studied with a journeyman. One day we had to rebuild a demolished portion of a conveyor carrier. I asked for blue-prints. He replied that we would "make it work," then the engineers would come and draw "pictures" of it. This was early "Field of Dreams" philosophy. If you build it, they (theorists) will come, and they will.

Thanks for the professional publication, *Infinite Energy.* Keep up the good work.

Budd Goodyear
Wasilla, Alaska

New Energy Times Archive

We are not experts on Reich and Orgone energy. However, Dr. Correa knows a lot about Reich's history. We suggest you examine his www page at:

http://www.globalserve.net/~lambdac

As for the dark matter ("missing mass") and the "aether," I suspect that this will all be tied together someday. Dr. Randell Mills, whose excess energy theory relies on catalytically shrunk hydrogen atoms ("hydrinos"), believes that these comprise the dark matter.

Yes, the theorists will come (belatedly), after the commercial new energy machines are built—just in time for the human family to be saved from the pool table corner pocket!—EFM

• — • — •

I would like to comment about your magazine and the quality of the scientific work done in it— in the manner of the writings. The work that I have read and also learned from is some of the most intelligent writing dealing with alternative fuels and other "fringe sciences." When most talk about them, there always seems to be a conspiracy behind these new technologies, with no sound evidence about it. But then there is your publication, which doesn't jump the gun in dealing with technology that seems to-good-to-be-true. In other words, you folks at *Infinite Energy* do your home work. That is something that more individuals need to try and do.

G. Tramell
Sentinel, Oklahoma

Thank you! We certainly try to "do our homework," but there is so much to do it is difficult to find time to do it all, but we keep trying.—EFM

• — • — •

Jed Rothwell (*IE*#9) offered a fascinating account of the parallel between the evolution of the science of flight and the still-in-the-egg stage of development of a "science" of free-energy in general, and of cold fusion in particular. A datum not included in the Rothwell account concerns an interesting blip in the history of Orville Wright's European tour

On an occasion in 1908, Wright made a demonstration flight in Rome, Italy. He had as a passenger, Lt. Thomas Selfridge. The "Flyer" crashed. Wright was only injured but his passenger was killed. Nineteen years later, February, 1927, Lester Hendershot demonstrated his "fuelless motor" to Colonel Charles A. Lindbergh. The locale was Detroit, Michigan's Selfridge Field — an airfield named after the deceased Lt. Selfridge. To add a synchronistic fillip, the name of the Field's Commandant was Major Thomas Lanphier.

Erwin Krieger
Cincinnati, Ohio

Thank you for that fine historical note. In the future, we intend to look back at some of the historical claims of over-unity, such as Hendershot's.—EFM

• — • — •

May I take this opportunity to tell you how impressed I am with the quality and content of your magazine. Little did I realize that before stumbling upon your magazine only by pure chance back here in the UK that such a journal was available to those interested in the field of cold fusion technology. After starting my subscription with you at issue #7, I feel I must also read th first six issues.

I would like to finish by saying that I will also be renewing my subscription with you when it is due, and look forward to following further developments in this interesting and intriguing branch of science.

Your very impressed reader.

G. Sutton
Cheshire, England

Thanks to appreciative readers like Mr. Sutton in over two-dozen countries (a subscriber in Iran is our latest addition), who "by pure chance" meet up with Infinite Energy, *we are able to offer continuing information to our global audience.—EFM*

• — • — •

First I would like to say how much I enjoy your magazine. It's the best source of Cold Fusion information I know of, and a major component in getting the truth out on cold fusion. I would also like to order a copy of FIRE FROM ICE .

I am currently working on my own cold fusion experiment. I'm using a H_2O-K_2CO_3-Ni Randell Mills-type cell. It consists of a 150ml PYREX beaker containing 100ml of a 0.6 molar concentration of K_2CO_3 in de-ionized water. The cathode is a 3mm X 10cm Ni rod (only about 3.5 cm is submerged) or a coil of 1mm Ni wire (wire is of 99.5% purity). The anode is also nickel. The electrodes are supported by a No.11 two-holed rubber stopper. While planning my experiment I found that some of the articles in "Infinite Energy" contained useful information. Especially the one on page 48 in the 1995 July-August edition, Issue #3, "Cold Fusion: A Study Involving the Fusion of Ions" by Michael P. Belcher). Like Michael I am a high school student, but I am not doing the experiment for a science fair. I'm doing it because cold fusion is my hobby.

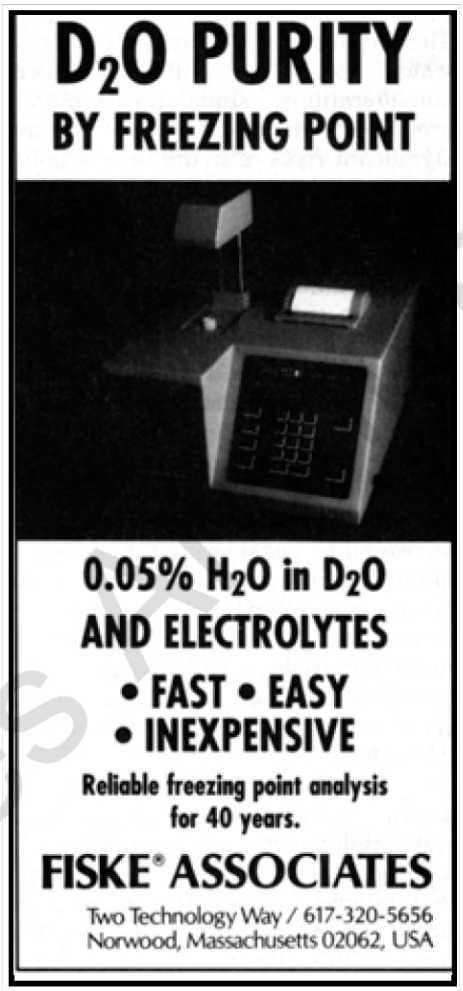
After reading a number C.F. theories (most of them in "Infinite Energy"), I suspect that the excess heat seen in light water C.F. experiments is caused by three nuclear processes that occurs in steps. They are as follows:

$$P + P + e^- \rightarrow D + \text{neutrino} + 1.442\ \text{MeV}$$
$$D + P \rightarrow {}^3He + 5.49\ \text{MeV}$$
$${}^3He + D \rightarrow {}^5Li \rightarrow {}^4He + P + 18.3\ \text{MeV}$$

But because C.F. cells release no radiation its hard to say exactly what nuclear reactions are taking place, so theories can only be plotted on a scale of probability.

-

Scott Thaller
Wexford, Pennsylvania



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Newton versus Einstein, by Peter Graneau and Neal Graneau. Carlton Press, 1993 Hardcover. 219 pages, $14.95. ISBN 0-8062-4514-X

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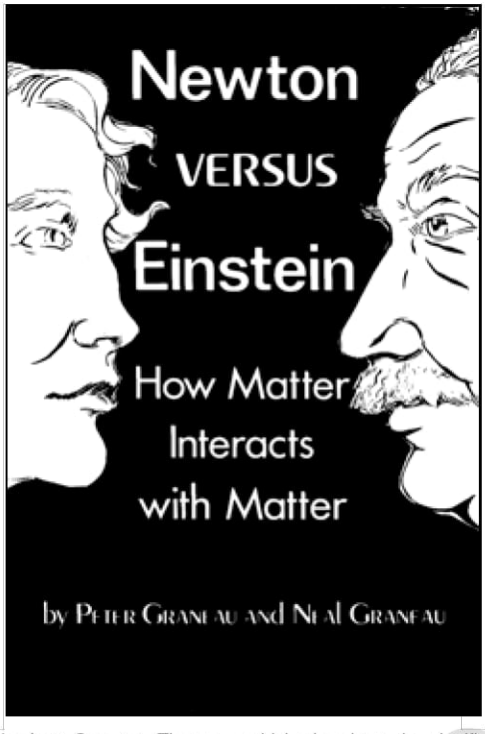
Praise for Newton versus Einstein

Inertia is a much-discussed topic. The Graneaus give a beautiful account in which they relate theories of inertia back to those of Mach at the beginning of the century. They view inertia as the result of the gravitational interaction of all particles in the universe on the body in question, instantaneous transfer making even distant galaxies a part of the interaction .

The authors feel, correctly, that there is a resemblance between the Academies of Science at present and the influence of the Church at the time of Galileo. There is effective censorship of ideas inconsistent with



the I926 Quantum Theory or which play down the significance of Relativity. If new observations do not agree with the present physics, the investigator is accused of fraud or sloppy science....

But now, the authors believe, the dust has settled and there are too many aspects of present physics that seem inconsistent with observation. The time has come for a Great Re-Think. There is a telling quotation from Einstein in a letter written towards the end of his life to his old friend Besso. It states that field concepts may be entirely wrong. If they are, Einstein says, then all his endeavors and the rest of modern physics are up for re-forming.

This little book is the expression of workers who really do try to penetrate into the darkness, instead of singing the old song in a new style. But scientists like the Graneaus will never win the Nobel Prize. They ask too many disturbing questions to obtain the support of the establishment scientists who decide who gets the Prize.

Professor John O'M. Bockris,

JOURNAL OF SCIENTIFIC EXPLORATION, Spring 1995

ABOUT THE AUTHORS

Peter Graneau is well known for a long series of experiments in classical electrodynamics performed during thirty-five years in university and industrial laboratories on both sides of the Atlantic. The results he obtained were consistent with the old Newtonian electrodynamics which flourished in Europe during the nineteenth century. Dr. Graneau has published his findings in more than forty papers in prestigious physics and engineering journals and in his 1985 book *Ampere-Neumann Electrodynamics of Metals*. Some of his work has been sponsored by the U.S. National Science Foundation, which commended him for his efforts. The Graneaus make their home in the town of Concord, Massachusetts. They love nature, and they walk and canoe where Henry David Thoreau lived. In this beautiful area, Peter Graneau has time to contemplate the course physics may take in the next century.

Neal Graneau was born in London, England, and attended Fenn School in Concord, Phillips Exeter Academy in New Hampshire, and Winchester College in England. He traveled with school theater and poetry groups, and played piano recitals. Neal Graneau studied physics at King's College of London University, and at Oxford University as a graduate student. He is currently a full-time researcher at Oxford. For ten years, he spent his summers in his father's MIT laboratory. There this father-and-son team researched, invented, built and performed the experiments described in this book. When not at work, Neal finds time to relax by playing the drums in an Oxford group.

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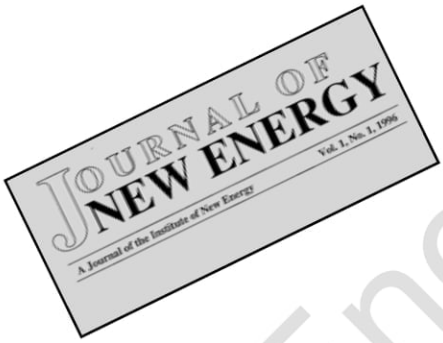
"Breaking through" continued from p.4

experiment." Well, he certainly gets an "F" on fact checking!

Waldholz quotes Taubes on the Utah researchers, "They convinced themselves they were right." Sigh! We can only hope there is a special place in hell for the likes of the pernicious Taubes. It will be a hell-on-earth for him when the true facts are known by all, as commercial realities in new energy development overwhelm the Big Lies. Yes, he has "convinced himself he is right"—without even going to international conferences or observing experiments.

But let us emphasize the positive. Your response to our SuperPower, Inc. investment fund proposal has been overwhelming. Plans are moving forward to attempt to launch such a fund, thanks to the courageous support of several key individuals. They may become to cold fusion and New Energy, what prescient investors in the past were to electric power distribution, flight, and the development of space propulsion. We will keep you informed as the experts we have consulted help bring this about.

We will keep on investigating nature's wonderful, heretofore hidden possibilities and spreading the facts about the coming energy and scientific revolution—with or without "New Physics."



Published by the
Fusion Information Center
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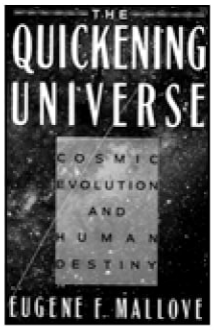

1987, St. Martin's Press, hard cover, 268 pages, illustrated by the author.

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An Interview by *Infinite Energy* Magazine with

Prof. Martin Fleischmann

8th February 1997

Conducted by Christopher P. Tinsley, Contributing Editor

T: Now that you are retired from IMRA, what do you intend to do? Are you really retired?

F: I don't suppose I'll ever retire completely. I retired from full-time work at the University of Southampton when I was aged 56, but I didn't "retire." I started a number of part-time projects and, eventually, of course went full-time to IMRA Europe. At the moment I am taking a very careful look at some of the work which we have done in the past. It has been suggested at various times that I should start an operation in the United Kingdom but — bearing in mind my age and medical history — I think this would be not a very sensible way to go forward. So I am now interacting strongly with a group in Italy. I anticipate that we will take a very careful look at what we and other people have done during the past eight years and move on eventually to try to implement some of the work which I have wanted to carry out in the past.

T: You've been giving some assistance to Mr. Evan Ragland with regard to his cell. This cell is of course the one which our magazine is hoping to provide to people as a demonstration device of the basic thermal effect.

F: I think my interaction with Evan Ragland will be principally concerned with the form of the electrodes. I have had this view of the optimisation of the electrode design for a long time. Historically we went through various phases in the work and eventually worked on large sheets — very large sheets — of palladium. That work was stopped in March 1988 because of concerns about the safety of the device. At that stage we switched to using rods, which, as everybody knows, we have used because we felt it was very important to be able to reduce the scale rather than to increase it again because of our concerns about safety.

T: Are you thinking here of mechanical safety in the sense of the famous "centimetre cube of palladium" incident?

F: Yes. That was always a big factor. You know, as the work moved forward, it included the work on this cube which disintegrated — unfortunately unobserved, because it happened at night.

T: Perhaps, very fortunately it was not watched under the circumstances?

F: Perhaps fortunately — yes. After that we moved to using sheets under very mild conditions. We tried to reduce the scale of the phenomena. Incidentally, as we were discussing earlier, this included unexplained increases in the temperature of the cell. In March 1988, we decided that we had to take further steps to scale-down the experiments.

Prof. Martin Fleischmann at home in England, near plaque with St. Austell saying.

F: There is a famous diagram which has Stan Pons' and my writing all over it, about these unexplained rises in temperature of the cell. As it happened, I was just recovering from an operation here in the UK. At that stage, we decided that this line of work had to stop and we switched to the rods. However, rods are not satisfactory mechanically because there is a stress concentration in the centre, so it is obviously better to use something like a continuous sheet. That's why I believe that we should now look at tubes.

T: Perhaps with one anode down the centre and another anode as a coil around the outside, so that you make a triode arrangement in that way?

F: Indeed. I think my interaction with Evan Ragland will be along that line.

T: In the matter of the centimetre cube of palladium, the solid block, would you say that the disintegration incident had some effect on you in the way of being a stimulus to your continuing the work?

F: Indeed, yes. It was our incentive to continue with the work but, at the same time, it was a one-off, so you can't really say anything definitive.

T: You don't want to do it again.

F: No, I don't want to do it again. You can specify various things which might have caused it. If you assume that it was a valid experiment, then its disintegration reveals a very substantial part of what has been found since then, including the fact that you can get heat generation at high temperature.

T: You're suggesting it was a thermal runaway of sorts.

F: Yes, you can see that even with a relatively modest enthalpy output and a uniform generation of excess heat in the volume, you would get rather strange conditions in the centre of the cube.

T: Rather like a haystack spontaneously combusting?

F: Yes, it is like that.

T: That although the process producing heat is at a comparatively gentle level, if you do that inside a haystack...

F: It'll catch fire. Yes. You can do the calculation on the back of an envelope to show you that this will happen, that it could melt in the middle. It's just strange that people haven't done this ...you know that people say "pooh, pooh, pooh, it can't possibly be," so the discussion never gets going. So if I could just go back now to something which I am sure we should cover here regarding our original scenario: we have, in fact, four ways — four major potential lines of research. The first was

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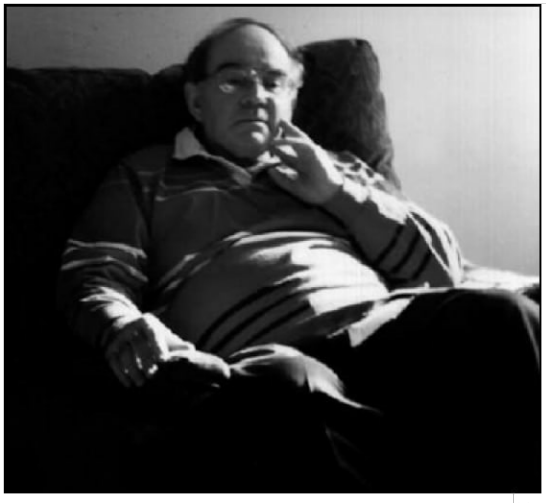

the topic electrodiffusion, I'm sure we shall cover that at some length; the second one was electrochemical charging; the third one was a collection of experiments which really bridged the topics of hot fusion and cold fusion. Interestingly enough — no-one has ever asked us about that, they are not in the least bit interested.

T: They perhaps haven't had the opportunity to ask that?

F: Well, what is so interesting is that no one has asked.

T: Well we are interested.

F: The fourth one was another set of experiments which I may do with my friends in Italy. So there were four distinct lines and, of course, we became committed to electrochemical charging although our real intention was always to work on electrodiffusion. A discursive answer to the first question.

T: We're just a few months on from the ICCF6 Conference. What do you anticipate will happen in the field in the course of the future from now on?

F: It is very difficult to say. I've always said there is the "seven year barrier." Yes, we've passed that. Usually, if you have a new idea, you very rarely break through to anything like recognisable development or implementation of that idea the first time around — it takes two or three goes for the research community to return to the topic. So I thought it would probably all peter out in '96 if we didn't break through, but I don't think it has done that. I think this is one of those situations where although people think it is crazy, the value is so high that they will continue with it. If you think about the meeting in Japan, what was revealed was that if you do the experiment correctly — especially with the correct materials, than you will make successful observations. As regards the materials aspects, I'm very keen on Johnson-Matthey material Type "A" or something which looks like Johnson-Matthey material Type "A". If you use that, you will find it relatively easy to to reproduce the findings in a reasonably short space of time. However, I think that the meeting revealed that there are several research groups entering the field who are doing this. I think that the real success will come from the next phase, which will include experiments in electrodiffusion or combinations of electrochemical charging and electrodiffusion.

T: We are seeing a considerable increase of interest in this whole general area —even in recent months there has been a considerable shift. And yet, of course, Max Planck set his "constant" at 20 years for new ideas to penetrate.

F: Did he? Well, he said that all the opposition has to die out, didn't he?

T: He said that science proceeds by funerals.

F: Yes, yes. There is a lot of truth in that.

T: And yet in cold fusion it's really not been the "young Turks" that have been coming in.....

F: ....it's the "old Turks."

T: Exactly.

F: I think that we were starting to talk about that earlier. I think this was a subject for older people who were not afraid to.....who didn't care about their scientific reputation.

There was a very unfortunate development in the 1970's...People developed a view that a subject is not respectable unless it is dressed up with a suitable overload of theory...

T: But perhaps in the past there have been periods where people have been able to do science without having to worry about their reputations?

F: That's gone now.

T: Perhaps it will come back.

F: Maybe it will come back. I think that at sometime we will want to talk about the general malaise of science.

T: John Bockris has suggested that science had become very rigidified in around 1972. Do you have any comment on that at all?

F: I think there was a very unfortunate development in the 70's, a sort of "anti-Francis Bacon development." People developed a view that a subject is not respectable unless it is dressed up with a suitable overload of theory, and consequently we have had this "top dressing" of theory put on the subject which has tended to make the approach very rigid. Also, the theories are of course written in terms of rather old-fashioned ideas.

T: But we have been seeing a shift in general public attitudes.

F: To science?

T: No. Specifically towards things like towards cold fusion. This may be a kind of pre-millennial tension or something of that kind, but we are finding that companies and individuals are taking the whole field of cold fusion very much more seriously and positively than they were doing even months ago.

F: I think that's probably true.

T: It's a strange thing.

F: I don't think so. I think that that it is a question of economics, I don't know whether you have done your calculations but, about two or three years back, I did a first assessment of what the first successful device would be worth and it came out at about 300 trillion dollars. So, at that sort of value, people are prepared to take a rather high risk on the research. You know, for a long time people have always had a list of the first ten projects. I don't think you should over-emphasise the value of cold fusion necessarily, but if you make your list of the ten most valuable projects, high temperature superconductors will always be on the list; fuel cells will always be on the list. It doesn't matter whether you can or cannot achieve high temperature superconductivity or fuel cells, they will always be on the list because if you could achieve them they would be extremely valuable. So these ideas will keep on coming up. Now, of course, cold fusion is the daddy of them all in a way, in terms of value, so I think that viewed in a social way, from the point of social considerations and economics, it will tell you that this thing will stay around.

T: Do you think that physics and chemistry took something of a wrong turning at some point in the last 150 years or so and started to perhaps head into something of a blind alley? That what we now are seeing — perhaps with cold fusion, and so forth — is that mistakes have been made? We have something that doesn't appear to fit comfortably.

F: I don't think so, you see, I am a very conventional scientist, really. Extremely. I

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always explain that — I'm really very conventional. We arrived at this TOPIC from various inputs to the subject and, in the end, we could pose a very simple question, namely would the fusion cross-section of deuterons compressed in a palladium lattice be different to the cross-section which you see in the vacuum. Now, I think that was a very simple question — either yes or no. The answer turned out to be different.....I should explain that what we said was, "Yes, it would be different, but we would still see nothing." That was the starting point in 1983 or whatever, yes 1982-83. Of course, it would be different, but we will see nothing. But it turned out to be radically different to that. Now, of course, you have to say, "What do we do with such an observation?" Many people — as was shown subsequently — even though they were told what had happened — couldn't believe this and ignored their own experimental evidence. But that is not for us.

As for taking a wrong turning — well it has in an organisational way. I always say that if you recall Leonardo da Vinci and Michelangelo holding a painting competition in the Town Hall in Florence during the Renaissance then you cannot conceive of that happening in the present age. The early development of science was really a dilettante type of aristocratic preoccupation...

T: Lavoisier and co?

F: Yes. You cannot imagine that somebody would now give a latter-day Faraday carte blanche to investigate the interaction of forces.

T: Mind you, for what he cost at the time, we could really afford it. It wasn't that expensive.

F: Nor is cold fusion expensive. One of my theme songs is that if you can't do it in a test tube, don't do it. It is not necessarily true that expensive experiments are not worthwhile doing but there are plenty of rather cheap experiments which are certainly worth doing. So if you haven't got the resources, do think a bit and try the cheap experiments. So has science taken a wrong turning? Well, this is one instance where it has taken a wrong turning, but, of course, there is also this whole overlay of Copenhagen-style quantum mechanics which we have not been able to shake off.

T: You feel that was a wrong turning?

F: Oh, that was a massive wrong turning. Massive wrong-turning, although we have to give credit to Niels Bohr and the Copenhagen school, for a great deal of valuable development of theory. However, that approach should have been abandoned a long time ago. The problem is that replacement of Quantum Mechanics by

Quantum Field Theory is still very demanding.

T: Now, how about the difference between, in cold fusion, but perhaps in science generally, the way things are done in Japan and in, for example, the United States? There are obviously significant cultural differences between the countries and this runs into the way they work in every field. A World War II Japanese battleship can't help but look Japanese. Perhaps you could include the UK as examples. How would you characterise the differences?

Many people...even though they were told what had happened — couldn't believe this and ignored their own experimental evidence.

F: Yes. That's an enormous collection of questions, it's not just one question. I just had an ex-student of mine here, who is now an academic in Coventry. He has a very interesting collection of post-graduate students working on a RANGE of topics. One of these led us to discuss globalisation in the context of the difference between Christianity and Islam, and I said, "Well, this is not the question. I think Islam and Christianity can be reconciled but Shinto and Buddha on the one side and Islam and Christianity on the other, that is a much bigger problem." The cultural difference between the Pacific rim and the Greco-Judaeo tradition is going to be a much bigger problem for the world. And, of course, I think that it is very difficult for people to lock into science if they haven't got the Hellenistic tradition.

One of my theme songs is that if you can't do it in a test tube, don't do it.

T: But the Japanese are notoriously fine co-operators....

F: Yes, they are very good at retro-science for example, where teamwork is very important, but I don't think their system lends itself to innovative research. I think that many senior people in Japan, who are now unfortunately dying out, realise that Japan will have to take a step towards innovative science, they cannot go on using innovative ideas developed in other countries and develop them themselves. Incidentally, this is one of the problems with the development of cold fusion — they went into it too soon. I think they have a very important role to fulfill, but by stepping in too soon — before the boundaries of the subject had been defined —then this was going to create a great deal of difficulty. So I think that as science is organised in Japan at the moment it will not make a great deal of headway in innovative science. That's my own opinion.

T: But, in Japan, is it not also true to say that they hold in very high esteem persons such as yourself — a Fellow of the Royal Society ....

F: Outsiders. A prophet is not recognised in his own land.

T: "A prophet is not without honour save in his own country." But is it not generally true that the Japanese have particularly strong respect for high-powered academics from outside Japan?

F: Yes. But this is because they don't recognise their own prophets. Because they don't fit into the system.

T: But then neither do we. That's a universal problem.

F: Well this has now come upon us. I think this was not true — especially if you take the United Kingdom — this was not true in the past. I mean prophets in other endeavours — politics or the social sciences — might not have been recognised, but in science, prophets were recognised in the United Kingdom.

T: Would that explain the disproportionate role that British science has played?

F: Well yes. I think you know that I classify science as British science, American science, and everybody else. British science has a certain style and, of course, my

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problem is that, although I was born in Czechoslovakia, I am the archetypal British scientist.

T: You are indeed.

F: I am. I am a caricature of what British science is about in the way I work. American science is much more organised, much more hierarchical than British science has been. I think British science is becoming more like American science — and then there is everybody else, I'm afraid. Is it not true that 55% of R&D, ie. innovative science, since the War been done in the USA and Britain.

T: So, it is extraordinary...

F: It is extraordinary and now, unfortunately, we have found ourselves in the position where I think some decisions have been taken by the mandarins in Whitehall that Britain should become a "super Belgium." The fact that we have not been able to exploit our ideas is taken as an indication that we should not do innovative science. When in fact, of course, what has been wrong is that we have not exploited our ideas. Removing the ideas is not going to do us any good whatsoever.

T: That's certainly a fascinating view. You say that science is a highly organised endeavour in the United States, but surely a great deal of innovative and exciting work has been done in the United States as well.

F: However, the cost is very high. It is not a very effective system, though they could afford it, or historically, they could afford it but the cost/benefit analysis of science in America is not very good.

T: Yes, I've always been entertained by chauvinism in science, for example, in this country we have Crick & Watson and in the United States we have Watson & Crick. There's an extraordinary and highly inappropriate chauvinism, is there not, in science or would you say that's only in the public perception?

F: It's in the public domain, I don't think scientists themselves do that. Scientists are really very conscious of the fact that they stand on the shoulders of an enormous tree of preceding workers and that their own contribution is not so enormous. What I've always said about cold fusion is that "everything I can say about cold fusion can be condensed onto about half a page now and I will know the subject has arrived when it is a footnote." When there is a lot of verbiage then you know you haven't arrived.

T: Is this your comment about from simplicity through complexity back to simplicity again?

F: Well that is part of it, yes, it is a little bit of it. You have to in the end, distill out that which is simple, to think about and re-investigate that which is simple to do.

T: Yes, that's very interesting. Arthur C. Clarke once had a character in a novel comment that the French make the best second-raters at everything in the world.

F: But that's their objective. It's a conscious decision. Historically they have been very good at mathematics, and occasionally you get a peak like Pasteur and they recognise the peak. I think you could hardly ignore Pasteur, but basically the French system also doesn't lend itself to innovative research.

T: And Russia?

F: Well, the Russians have been extremely innovative considering their resource base. So how one should analyse this, why the Russians were so successful? It's a good question.

T: Perhaps they have been in a continually post-diluvial state.

F: Probably yes, I think they could only escape from the system via some sort of profession. You had to hide within your profession. You know, you had to become immune from the political pressures.

T: If you became a Sakharov no one could touch you seriously - though they tried.

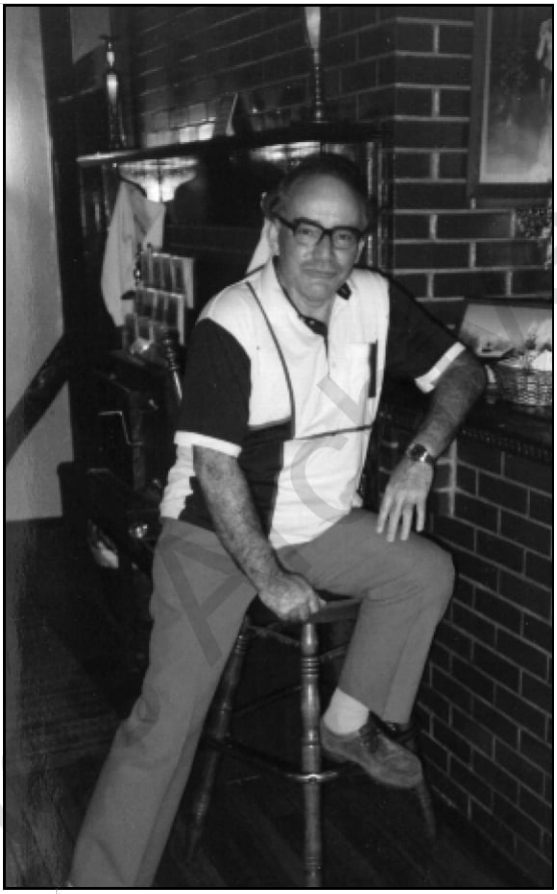
F: But if you even go lower down the scale, scientists were left alone, so the clever people who could make it into science hoofed it and made it into science as fast as they could.

T: To return to cold fusion: if you had to do it over again, would you have participated in that Press Conference in 1989?

F: Here again, is an enormous collection of questions. Of course, I was opposed to it as you probably know and I tried to stop it — even the night before — and I failed because there was a key person I needed to contact.

Stan and I funded the first phase of the work ourselves. It was secret. We reckoned we would get our first answers for about $100,000, which was as much as we could afford to spend. In the Summer of 1988 we reckoned that we would need $600,000 to complete the first phase in about September 1990. We planned to review the question of publication in September 1990.

We had at that time, and continued to have all the way through, tremendous hang-ups about whether this work should be published at all. In fact, in '88 we went through several discussions about whether the work should be classified.



Martin Fleischmann in 1990 at Mill Creek Inn in Utah
(Photo Courtesy: Dr. M. Srinivasan)

T: For reasons of....

F: National security. However, in '88 we had the twin problem that we certainly did not have $600,000 between the two of us to spend on progressing this research properly, and we needed the $600,000. We also had to inform the American Department Of Energy in the States, and I had to inform Harwell [*Laboratory in the UK—Ed.*] about this work. So I said let's kill many birds with one stone: let's write a Research Application rather than a patent — which we submitted to the DOE. Initially, it didn't go to the DOE, but it finished up at the DOE in August 1988 and that, of course, brought us into this conflict situation with another scientist who was interested in the subject, who had been interested in the subject previously. He had not done the experiment in a way in which he could possibly have succeeded, mainly because he had used 10% D_2O in H_2O and, of course, he would have had hardly any deuterium in the lattice — and he started to work on this topic again.

There is nothing wrong with that incidentally, people object to that, but I don't object to that at all. I think that he should have disclosed his intention to restart his

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work when he refereed our proposal. What was hard for Stan and me was that he wanted to disclose his results. Now Stan and I were still working in secret at that time but, because of this development, we had to inform the University of Utah because we thought that they might need to take patent protection. They said yes, so then the patent became the driving force. And it was the patent consideration which produced the Press Conference, the "prior claim." I was not in favour of that at all, but it was that which produced it. Of course, you might ask if we would have done it any other way. Well, I wished we had carried on for 20 years in a mild way and I wish I had started it in 1972 and done it all myself, quietly and over a long period of time. I think the Press Conference was a mistake. But it was inevitable.

T: Can you, looking back, see any alternative to what happened?

F: No.

T: You would have been stuck with the same situation?

F: Given the situation we had and given the results we had, we had to tell the DOE and Harwell. Given the conflict situation which developed we had to tell the University. Given the results we had, the University had to take a patent. It was inconceivable that Chase Peterson and Jim Brophy would have said, "No, we won't take a patent." The only thing which would have changed that would have been the existence of an Ethics Committee to whom it could have been submitted — a National Ethics Committee would have said this is not the sort of science or development which justifies taking a patent, forget the patent, no press conference, no nothing, it would have been OK. But, given the situation in which the Universities found themselves, I think it was inevitable — and it would happen again, and in other fields it will certainly happen again.

T: I for one see no clear objection to what people dismiss as science by press conference. After all, the hot fusion boys do it all the time.....

F: I think it is worthwhile to recall Zeta. Zeta [*A supposed hot fusion achievement.—Ed.*] was announced by the Postmaster General in the House of Commons. What can be more outrageous than that?

T: Quite. But I was thinking that, for example, I would very much have welcomed a Press Conference by the French nuclear research people, CEREM, on their full replication of your "boil off" experiment. I'm sure you would have done as well.

F: Hmm — hole in the corner.

T: In other words, if you've got it you flaunt it. Did you notice that any mention of the CEREM replication is totally absent from Douglas Morrison's account of ICCF 6?

F: No, I haven't looked at that. =But can you imagine something which has been so systematically ignored as that announcement?

As regards MIT, all one can do is shake one's head in disbelief really. I mean, again, if you fiddle about with baselines then you have to consign those experiments to the dustbin and start again.

T: Surely, but was it announced publicly.

F: Well, Biberian presented this work.

T: Ah, but only at this Conference. Where else has it been announced?

F: I think what is going to happen is that a lot of this work will disappear behind closed doors.

T: For what reason?

F: Three hundred trillion dollars.

T: The energy business?

F: I mean, other reasons as well, just take that as a...

T: But you are thinking, in this instance, of the energy implications?

F: Yes. But there are other implications as well. But let's just confine our attention to energy.

T: Quite. You recall the famous sequence of events at MIT, and Mitchell Schwarz and Gene Mallove's discussion of that on the BBC/CBC documentary. Have you any comments to make on that particular series of incidents?

F: It was certainly very extraordinary. There were three, possibly you could say there were four, investigations in 1989 that we should have taken notice of. One was the MIT investigation, another one was Lewis at Caltech, the third one was in Harwell, and possibly we should take note of Kreysa and his colleagues in Germany. I think the last is a minor thing — a fairly ridiculous investigation. I think the only half-way reasonable investigation was the one in Harwell, that experiment was well designed but badly executed and, of course, totally misinterpreted.

However, to their great credit, they made the data sets available for study. This is Harwell.

T: Of course, MIT did that too in a sense, eventually.

F: In a sense, but see what happened. If you take the Harwell data sets, you cannot say that this experiment worked perfectly and that there is no excess heat. You could only say either that the experiment worked perfectly and there is excess heat, or the experiment didn't. And on those two bases you have to do another set of experiments. As regards MIT, all one can do is shake one's head in disbelief really. I mean, again, if you fiddle about with baselines then you have to consign those experiments to the dustbin and start again. The one in Caltech, was clearly very strange because there was a redefinition of the heat transfer coefficient.

I had actually thought of dropping out of this field in '91 and just waiting to see what other people would make of it in order to go back into it in '93 myself, but I was persuaded to go to France.

T: Just one moment, to track back, you were talking about the Caltech experiment — you said something very strange happened and there was a redefinition of the heat transfer coefficient.

F: The heat transfer coefficient. I'd have to refresh my memory, but my own view was that it was much more plausible to reinterpret the MIT and Harwell and Caltech results in terms of the generation of excess heat.

T: Yes, but that experiment was discussed in a paper in the *Journal of Physical Chemistry* some while later, was it not? Did you see the paper there which largely refuted the Caltech experiment and showed there had been excess heat? That was one of Miles' papers.

F: Was it? Well, yes, you know it's not very difficult to show that you get excess heat if you use the right material. Of course, it's a materials science question. If your electrodes crack you will not load them electrochemically. You can load them some other way but not electrochemically.

T: This is all connected with the same period that you were effectively accused of fraud by Parker of MIT. What were your feelings about this?

F: It's insane, really. But Parker had an axe to grind and Parker tried to deny he was the lead author of the paper. I think it was Mitchell Swartz who caught up with him mainly, and Gene Mallove, then Parker somewhere said, "I don't know, nothing has happened," and then someone said, "But you are the author, the lead author!"

T: In fact, the BBC documentary showed

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Parker in a very poor light.

F: So who called me a fraud?

T: Who indeed?

F: I shouldn't say fraud. Fraud is not an acceptable word, but who created a deception.

T: "Inappropriately interpreted the data."

F: Who inappropriately interpreted the data. Which is very common incidentally, I was recently writing to my Japanese colleagues about misinterpretation of data. Science is full of misinterpretation of data. Because data interpretation doesn't hold a very high priority in science, it is driven by the Research Student Syndrome: "Let me get all these results now and I will interpret them next year." Next year, of course, never comes.

T: One of the first things which convinced me to study the field very much more carefully in the early days was Professor Close's book on the subject. It seemed to me he was tying himself into logical knots to try and explain the results away. I felt that there must be something in it for a man of that calibre to have to go so low. Such comments of his that when heavy water was later found to be contaminated with ordinary water, that this showed that somebody had been tampering with the experiment — and I can't believe a nuclear physicist is unaware that heavy water is hygroscopic.

F: Well, contamination is a big problem, you know. I think this is a very interesting point. If you have a very low level of contamination by light water you will certainly destroy the effects due to deuterium.

T: He was explaining the presence of tritium by saying that it must have been contaminated by tritiated water, because there was tritiated water available and the presence of ordinary water in the heavy water proved that somebody had been contaminating it. In fact it proves nothing of the kind.

F: This thing about the tritium was very interesting for us, because this was something we never wrote up properly at the time, and we have never returned to it because we have got certain hang-ups about this aspect. But, to explain our results with tritium, we would have had to have an isotropic separation factor between deuterium and tritium, this is the ratio in the gas to the liquid phase at about thirteen and a half. You can't get that. There's no way we could have got that much tritium by isotropic separation. So it had to be generated, you see, and other people have found that since.

But Close, I don't know, I can't understand Close. Frank Close came to see me. I had to return in February 1990 to Salt Lake City, and he wrote to me saying that he wanted to come and talk to me because he had been in Oakridge and he had seen the results in Harwell which were negative, and he'd seen the results in Oakridge which were positive. There were two groups in Oakridge who had positive results at the time that was Hutchinson and Scott, but there was a third group which had positive results in Oakridge and I had just finished with all this calorimetry here. So I said, "Come, I'll discuss it with you." And he came here and it transpired that he really wanted to talk about the gamma rays. I said, "I haven't got those data here, come to Salt Lake City because we've done a new set of measurements there on gamma ray generation," and he never came. He came to Salt Lake but he didn't come and talk to us, so he never had access to all the stuff which is in *Il Nuovo Cimento.* So that's my knowledge of Frank Close.

T: That leads onto another question. Do you feel that there is any further clarification you can give in your answer to the accusations from Close and others about your supposedly unethical shifting of the gamma ray spectrum?

F: There is a whole set of files upstairs and you are welcome to have them in due course. I think that the point about that was that I went to Harwell when I came back from the States, and I used the diagram which I had prepared in February '89 from data which had been given to me by my collaborators. There was something obviously wrong with those measurements. I went from Harwell to Switzerland and I asked for the final version of the diagrams to be sent to me in Switzerland.

I don't take kindly to being accused of unethical doings by people who clearly have been involved in unethical activities themselves.

So it's one of these unfortunate things. You can't really say what happened, but the diagram I used in Harwell was a preliminary diagram and when David Williams asked me whether he could have these diagrams and I said, "Yes, if they are for your own study, please don't distribute them; for your own study you can have them." These are the diagrams which Frank Close then got, which he shouldn't have got. I would certainly not have vetoed his use, but I would have wanted to add a word of explanation about how they had arisen.

There is one important issue here. By March 1989 we had decided that these measurements had to be done with a high resolution Ge-detector, not the low resolution Na-I detector. The results of these measurements were available in Salt Lake City in February 1990.

Subsequently, I tried to get these transparencies back to see how they might be related to the material in Frank Close's book. I was told by various people in Harwell that they had been lost. So Frank Close got them and Harwell lost them. The whole thing looks rather doubtful to me.

In other words I don't take kindly to being accused of unethical doings by people who clearly have been involved in unethical activities themselves.

T: Speaking of people being accused, what do you feel about John Bockris and his various problems — like horse manure in his letterbox?

F: I didn't know that, did he have horse manure in his....

T: Yes, recently.

F: Really.

T: Well you know he held a conference on low energy transmutations and had to hold it off-campus. I just wondered if you had any comments, because Professor Bockris is a fine, forceful old gentleman, is he not?

F: Well, he's another one who doesn't care about his reputation. Well, he does, but not to the extent where he would let it cloud his judgement.

T: Yes, that's a very interesting point — the matter of reputation. If one was looking for the world's most highly regarded electrochemists at the time one would have to include yourself and Professor Bockris in a very short list. This is interesting — that both of you have been perfectly happy to take such a stance, rather than resting on your laurels.

F: I think I must interject something here. People said "Why would you do it?" We can come back to that, but I said in reply to them, "Well it is not clear that it should have been me, but I think it would have been very likely that it would have been an electrochemist who would have done this research." Because of the nature of the subject you see.

T: What is the "nature" of electrochemistry, then?

F: Well, it is the interaction of physical chemistry and theory. You know, it is the combination of knowledge. Your knowledge base which would make you pose the question, "Is it not possible to induce

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anomalous nuclear reactions from deuterium in palladium?"

T: So, you would say that an electrochemist is rather like someone standing where three countries meet?

F: Yes. A gas-phase man wouldn't think of it all.

T: Are you interested in any other, shall we say, "controversial" areas of science at all? Are there any things which most people would perhaps dismiss, but perhaps you have a less certain view.

F: Yes. Well, cold fusion is part of a much wider area, and I have been really quite uncertain that our theory and understanding of condensed matter is at all satisfactory. However, I'm not interested in some of the more extreme ideas which have been put forward and which interest you, you know in the future of energy.

T: I will say that some of this gravity modification stuff does, in fact, appear to have a theoretical basis as well as some experimental evidence...

F: Well, if you think about gravitation, until we have a unified field theory, then you can't be sure what is going to happen.

T: Even Frank Close said that we don't know much about gravity, and anything might happen.

F: We really have an incomplete understanding. This will change, but there are one or two notable exceptions, which I don't want to talk about now. We have no understanding of quantum gravity and until that happens we can't be sure that nature won't play some rather strange tricks. As I told you when we were talking before, we had about four projects which we were working towards, one was to do with gravitation, one was actually to do with the behaviour of electrons in metals. We actually started to collect equipment together to investigate the behaviour of electrons in metals. But...

F: I have told you there have been certain themes which have run through my work, although they have never really been disclosed. I have often worked on topics where something short of the final answer would nevertheless be quite interesting.

When I think about what I have done, I find that I have failed to achieve any of my longer term objectives.

T: A pretty impressive failure, surely?

F: I have been content with what I have achieved, but I have not achieved what I wanted to achieve.

T: Which was?

F: To gain a better understanding of condensed matter. In order to do so, as with the cold fusion story, I find the answers to the global questions have eluded me.

T: Most of the truly exciting science over the last half century has been in condensed matter, you are saying?

...there have been certain themes which have run through my work.... I have often worked on topics where something short of the final answer would nevertheless be quite interesting.

F: Yes.

T: In terms of value to humanity, it has been *the* area of science which has been of the greatest benefit.

F: However, there is a lot to be said for working in high vacuum. Curiously enough, I am again extremely interested in the behaviour of thermionic diodes. I find I do not understand how a thermionic diode behaves. As I am interested in the interaction of charges in electrolytes, I think about simpler systems, and from that try and understand the behaviour of the thermionic diode. I do not understand it; and I don't think that anybody else understands electrons in a vacuum either.

...I was more interested in History and English Literature t han I was in Science.

T: In that case, to me, the number of things I don't understand is increasing all the time.

F: I sometimes believe that I don't understand anything.

T: I'm happy to say I'm at least beginning to make some progress in the direction of not understanding...

F: Well, you have worked in this field, haven't you. Just think of the space charge around a cathode, you understand that?

T: Well I must admit, to be honest, I've rather tended to take things like the thermionic diode pretty much for granted.

F: Well, before our next meeting try to tell me whether you understand the space charge around a cathode.

T: I will. If something had prevented you from becoming a scientist, is there some other...

F: Oh yes.

T: What would you have liked to have done?

F: I could have done many things. Basically, I was more interested in History and English Literature than I was in Science. It is, you know, very common for chemists to be interested in history and it was really very difficult to choose. Shall I tell you why I became a scientist?

T: Please do.

F: I did not think I could have a rewarding career if I went into Arts.

T: In what sense a rewarding career?

F: Well, an intellectually rewarding career. I decided to do science because I could see.....this seems a very sort of cold-blooded decision. Well, it was really. A somewhat mature decision for a child of 16.

T: Yes, I can believe that. Staying with your history, what can you tell us about the route your family took to come to England from Czechoslovakia before the Second World War?

F: I have told Gene some of this.

T: You have, but I think he's rather hoping you might still say a few words for this interview as well.

F: Well, it was quite sort of accidental, as so many things — really formative things — in one's life are accidental. We had got caught up in the German occupation of Western Czechoslovakia and we managed to get out. I always tell people I had the unique and unpleasurable experience of being arrested by the Gestapo at the age of 11. These things tend to concentrate your mind somewhat, you know, and my father was very badly beaten up by the Nazis. However, we got out. We were driven across the border by a First World War comrade in arms of my father.

T: He had been with your father in the first war?

F: Yes. He was a fighter pilot in the Austrian Army, and my father was an artillery officer, but they were very close friends. They were big heroes locally. He drove us across, he had a taxi firm. He himself drove us across into the unoccupied part of Czechoslovakia. That was the first time we got away, and the second time, it wasn't clear where we were going, we might have gone to Canada or Argentina — or South Wales actually. But we couldn't get any money out. My parents

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were going to start a factory in South Wales, but this couldn't be arranged, so we lost everything, and in the end my sister was adopted by a Methodist Minister and his wife in Cheadle Hulme and the wife's brother lived in Llandudno and she told him that he had to adopt me. Which he did. He was a bachelor and he adopted me.

I find this very difficult to talk about. I must say, when Gene asked me about it, I burst into tears — which I am prone to do when I recall this ancient history. At that time, my parents also got permission to come to England, and we all got on the train in Prague and came to the Dutch border and the Germans cleared the train of all refugees and we were in the last coach and my father said, "No, sit tight, don't get off the train," and the train pulled out of the station. So that's how we got away the second time, and arrived at Liverpool Street Station with 27 shillings and sixpence between the four of us.

T: And how were you treated afterwards?

F: Marvelously.

T: This country treated you well?

F: Yes.

T: In what way?

F: In everything. We had the most unbelievable consideration.

T: Because not all people coming into this country nowadays as refugees are so well treated.

F: Well, it's gone.

T: The old spirit has gone?

F: The old spirit has gone. Maybe it was a luxury of the upper classes. Or whatever.

T: You think so? After all, do you not recall the battle of Cable Street when the British fascists were put to rout by the mob in the East End of London?

F: Yes, that is one thing, but the consideration of the refugees I would have thought was a middle class/upper class aspiration, really.

T: So you were set up as it were, in this country?

F: No. My sister went up north and I went the other way to Wales and then my parents were going to start a chicken farm in Sussex, but then my father died and then my mother started this toy firm.

T: Really?

F: Yes. During the War, converting unusable scraps of materials into toys and dolls. The stuff she used would have been burned, you see. And it was her lucky break because her first doll — we used to keep it — resembled Benito Mussolini and she said, "This is the Mussolini doll," and she said the only reason she succeeded was that there was no competition! The dolls improved very quickly. Actually, she had training at the Art School in Vienna so she was a good designer.

I had the unique and unpleasurable experience of being arrested by the Gestapo at the age of 11. These things tend to concentrate your mind somewhat....

T: So things improved for you?

F: Well, at times it was a little touch and go!

T: Moving forward, what are your recollections of meeting with Julian Schwinger in Salt Lake City?

F: Well, I didn't meet him as much as I would liked to have done. Julian Schwinger came to talk to various people in the Chemistry Department, including Jack Simons. Julian Schwinger didn't have such a closed mind, and he could see that such a process in condensed matter could not be interpreted in a conventional way.

I was so preoccupied, I didn't talk to Julian Schwinger as much as I should have done. Subsequently, of course I talked to Giuliano Preparata and that was really a meeting of like-minded people, because he thought of it in much the same way as I did. Of course this may mean that we are both wrong!

T: I suppose that, in a sense, your sort of early experiences, you say that to be arrested by the Gestapo at that sort of age is something that would wonderfully concentrate the mind. It would put the sort of difficulties you have had since 1989 in perspective, I would imagine.

F: I'm sure.

T: When you think of such people as Fred Hoyle, for example, who take this very Yorkshire approach to their difficulties — that's fine, but for yourself I would say perhaps it was based on your past experience? You might have been a Fellow of the Royal Society and everything, but ...

F: I might have been dead.

T: Yes, somewhere inside yourself you would be the 11 year old boy with the Gestapo, so you just don't take some of these people very seriously.

F: Not really. No.

T: Gene mentions that he's heard that you don't aspire to such things as the Nobel Prize, and I've heard there's a lot of politics in getting the Nobel Prize, but what are your comments on that?

F: I think that's another thing which has gone wrong, you know. I know of quite a few Nobel Prizes which have been awarded to people for work which is manifestly incorrect.

T: Like Millikan, for example?

F: That's an early example, but more recently... It's accepted — socially accepted, but obviously flawed. So has it been a positive influence or not — I don't know. First of all there are a whole lot of Nobel Prizes awarded to people for work which is incorrect, or prizes which are awarded which clearly should have been shared between several such workers, and prizes which have been awarded to people who did not do the original work — that is very common.

T: Or not awarded to people like Fred Hoyle, perhaps, for his work on solar nuclear processes.

F: Yes.

T: But should have been.

F: Yes.

T: Because he was not playing the party line.

F: Well, he's had some cranky ideas which has coloured the rest. The question is whether Nobel Prizes are judged for an original contribution or are they judged for the totality of the work. Or can the totality of the work detract from the original contribution.Unfortunately, of course, this has happened in recent years.

T: There have been two "branch points" in cold fusion: the nickel/light water thermogenesis or whatever you would call it, excess heat, as particularly exemplified by the Clean Energy Technologies' cell and the work of Mills and of Miley. That is one branching point which the science has taken, and the work in very recent years which points to host metal transmutations - hydrogen/metal fusion. These are two diversions away from the classical process, even if the latter would be more of an alternative explanation or interpretation, whether you look at them as great heresies of cold fusion or great branch points.

F: Well, I have commented on the light water work before. To put it into perspective, Douglas Morrison came to see me when I was in Switzerland and said: "Martin, if I were a man from Mars would you expect me to believe this?" I said, "No, Douglas, no of course not. I realise all the difficulties." So, I realise that there is a credibility problem for d-d processes. I

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realise that it is much more difficult still to justify H-whatever processes, and then I said I had not done enough work on that myself to express an informed opinion, but that is as far as I will go. I can see there are difficulties with regard to light water, I can see the difficulties.

Stan and I set down the protocol for the experiment we did so as to exclude as many difficulties as we could: secondary reactions, all sorts of things. Not potassium carbonate, please. We used lithium deuteroxide, the simplest thing, prepared the simplest possible way — the simplest possible system we could set down. No chemical complications.

I think it would be quite difficult to prove absolutely that there are never any chemical complications in the light water work. Also of course we use high current densities and they use low current densities, so there are always problems with possible side-reactions. But I would never pooh-pooh it because I think that I just don't know whether you might not induce peculiar reactions with protons. I don't know. So that's one thing I would say about that.

Now the transmutation. Of course, I can think of several ways in which something like transmutation could take place.

T: Any form of nuclear reaction is transmutation anyway. So it's a very very small step.

F: But we do now know that there are high energy X-rays. Gozzi has observed them to over 120 keV.

T: That's a big number.

F: That's a big number, which, incidentally, can't arise from the electrons in k-shells.

T: What is the maximum for that? About 15 keV?

F: Well, whatever it is, but.....

T: It's a lot more.

F: Yes. It cannot arise from anything in the electronic shells.

T: 100 keV? No way.

F: No way, no way. So this has got to be some peculiar phenomenon. Incidentally, this is a fairly important question because, as Preparata pointed out in Japan, if you have got high energy X-rays coming out - and this goes back to Stan Szpak - lots of people then say, "Well it's soft X-rays," but soft X-rays would never get out of the cells. So they had to be hard X-rays. Those could dump their energy outside the cell, so you can see a lot of the complications with the thermal measurements could be just that people have missed the excess enthalpy with their cell design: the cell is too small, it won't catch the excess energy, and in any case it's only the lower bound that you catch, you must design a cell to trap all the energy in the X-rays. Once you have got the X-rays, you can ask what sort of X-rays, what is going on? Are these coherent X-rays? What would they do? Will they yield some sort of photo-fission processes in the nuclei?

There is a great bag of physics which simply will not fit into the existing paradigm.

So I could think of lots of processes which could be going on, and it will take a long time to sort that out.

T: Would you say that we are talking about systems whose complexity compares with normal nuclear physics in the way that perhaps biochemistry compares with inorganic chemistry? Are we are talking about things that are at a wholly different level of complexity, in a very complex multi-body process?

F: I think that we will find that when people have got some sort of explanation for condensed matter physics, based on single-particle descriptions, they must find it extremely distressing to now get this body of information which cannot be fitted into this framework. And there's much more to it you know, there is a great bag of physics which simply will not fit into the existing paradigm.

T: Could this be some kind of "complexity" effect in itself? That we are now beginning to understand that systems built out of units which individually behave very simply can, in conjunction, produce extremely complex effects?

...a correct understanding of condensed matter physics in general, and electrolyte solutions in particular, is a pre-requisite for taking our next steps in chemistry and biology.

F: Well, yes. I went through this in the 1947 understanding of the work of Alfred Coehn on electrodiffusion, and understanding at that time that even with the existing understanding of quantum mechanics —which was all that I had at that time, I think all that anybody had — you could then conceive of changing the conditions of deuterium in a lattice so that you would change the fusion process. Then I did a lot of work in the 1960's which led to this idea that solutions really have to be understood in terms of quantum electrodynamics. Not in terms of classical mechanics or even quantum mechanics. It had to be in terms of quantum electrodynamics, and then came all the work on palladium which I have worked over several times in my life. There was one very big slug of work in '67/'70 which convinced me that you could not talk about anything to do with hydrogen or deuterium in palladium in terms of single-body processes. These had to be many-body processes. The explanation for the behaviour had to be in terms of many-body effects, and that then triggered the cold fusion work. It's that which convinced me that it was worth going on.

I still didn't have the whole explanation, in the way Preparata has achieved the whole explanation, I only had 50% of the story. If I'd had all Preparata's insight into this I would have dropped everything else and gone for electro-diffusion, even if I'd had to do it in my kitchen.

T: It's very interesting that you are talking about cold fusion as really being a single aspect of a much larger idea of condensed matter physics.

F: I think, really, that a correct understanding of condensed matter physics in general, and electrolyte solutions in particular, is a pre-requisite for taking our next steps in chemistry and biology.

T: Biology as well?

F: Biology especially. And that's going to be more significant than cold fusion.

T: Where would you think this would lead us to, for example, in biology?

F: A totally different understanding of biological processes.

T: Could you amplify on that at all?

F: Well, no - not at this stage. I'm just writing a proposal. But I will talk to you about that in due course.

T: We made up a list of people you might like to comment on — Steve Jones, John Maddox, Huizenga, Frank Close, Mark Wrighton, Gary Taubes, Richard Petrasso and Doug Morrison?

F: I should explain to you that I have not read Close's book. I have not read Taubes' book. I have, however, read Gene's book.

T: Which was wonderful, of course!

F: Yes, and I have not read all Douglas Morrison's messages and newsletters. People have stuffed various things under my nose which irritated me intensely. But what do I think about them? Let me tell

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you.

F: Steve Jones? Well, he's an ambitious person. Let's give him some credit. He has some vision, he's very ambitious but I think his ability is not up to the vision he has. That's my comment on Steve Jones. This is not to say that he is a bad scientist, second-rate in science is very good. The problems he wants to do, he just hasn't got the technical competence to achieve them.

John Maddox? Well, he's a typical establishment figure, isn't he? We have to have people like that. He's out of it now — but I can't understand how his brain functions. Sometimes you are confronted with these people and you say, "What makes you tick? How can you function? I don't understand...."

T: "What's your problem?"

F: Yes. "What's your problem?" Huizenga? Well, I thought he was just a front man for some organisation which the DOE had cobbled together, really. I still think its a piece of disinformation, I think a lot of Frank Close and Huizenga is disinformation. If you could ever get into it, you'd find it is disinformation.

Up to a point Maddox probably as well. I think Close is a better scientist than Huizenga. A disappointed nuclear chemist who sees his field disappearing; his life's work is disappearing. And could easily be manipulated by people unknown.

However, I must tell you that at the outset, when Admiral Watkins was in charge of the DOE, I said to Stan Pons, "Stan, what if Admiral Watkins had been me and I had been Admiral Watkins? I would have done to him exactly what he is doing to us." I could not conceive of Admiral Watkins welcoming the notion that the American Universities and goodness knows who else working on nuclear physics in chemistry departments. This is where we came in. "We've got to keep it secret, we've got to have it classified! We don't know what's going to happen!" I think we will be proved right. In '88 we had no idea of the totality of the subject. We proposed to the DOE some things which shall be nameless at this stage, but we had no idea what would happen. We knew what we had got, which I think was sufficient indication it should have been classified.

And then in 89, of course, we said to the University, "We will go to Oakridge or to Los Alamos for two years and see how far we can get." And they said, "Do you really want to work with the Government? Wouldn't you rather work with General Electric?"

I wasn't asked that question but my answer would have been, "Yes, I do want to work with the government, thank you very much, I'm off to Los Alamos tomorrow." [prolonged laughter] If they would have had me!

Frank Close? I don't understand him either, really. He's a theoretician, not top flight. Well, he's OK, but again I think he has been manipulated.

Mark Wrighton? I shake my head. He's out of science now, isn't he? He's become a provost somewhere.

...regarding Huizenga, Close, Morrison, I feel that if you really could penetrate behind the smokescreen you'd find that other people have been manipulating them.

In days gone by when I used to be asked to referee a lot of material for promotion in the United States, I used Mark Wrighton as a benchmark for excellence, also Rick van Duyne and Al Bard from the older generation, so I obviously thought highly of him as a scientist.

Up to a point Nate Lewis too. I used him as a benchmark.

Gary Taubes? Well, nothing. A second-rate science writer. Primarily, he is a very bad journalist.

Richard Petrasso I think is a capable fellow, quite frankly. I think he is a capable fellow.

F: Douglas Morrison, I think, is another disappointed man. Quite a good analytical mind in some ways, but again I think he is manipulated. I think that if you look at this, you would say Jones can't forgive himself for what he did, so he keeps on trotting out these negative ideas. Jones is in a difficult moral position, and so some of his actions post-1989 had to be, as we said in Czechoslovakia, "holier than the Pope."

F: However, regarding Huizenga, Close, Morrison, I feel that if you really could penetrate behind the smokescreen you'd find that other people have been manipulating them.

T: What sort of people? We're coming close to conspiracy theory. Is this the "Protocols of the Elders of Britain"? What are you really saying here?

F: Well, that there are always groups of people who decide policy, aren't there? For example the Jasons. Lewis is a member of the Jasons, Garwin is somewhere near the head of the Jasons. They advise the Government. So what role do the Jasons have in this? Maybe none, maybe some. Garwin was interested, so was Teller. So who manipulates whom? Or perhaps they do not manipulate, I don't know. I don't think these things are spontaneous.

T: I think one difference in opinion I suppose an inevitable one because of our unique approach—one difference between ourselves and yourself has been that we have argued and pushed and are, as you know, working for clear public "in your face" demonstrations. I don't know whether you read Rothwell's comments on the Wright Brothers. He mentions for example that these so-called mechanics actually predicted the performance of the first air screw to within a percent before carving it. They were obviously very competent people, but they were beguiled by an idea that they had to do secret deals with all these Governments. They didn't realise that until there would be some general recognition of the existence of flight, you couldn't sell aircraft.

F: This is precisely the point I have made here: "When do you anticipate that the course of public opinion will turn in favour of cold fusion?" The answer is that you have got to get to a demonstration device.

T: Well, that's what we are trying to do, as you know.

F: Yes, and I absolutely agree. We have all the science, we had systems of Type A, systems of electrodiffusion, systems of Type B, systems of Type C which made the link to hot fusion, systems of Type D - very interesting, but I am not prepared to talk about systems of Type D at the present time. Nevertheless, we focussed absolutely at systems of Type B to try and bring this to some sort of demonstration device, because this is the thing which will change people's opinion.

T: But I thought we were in disagreement with yourself in this area—that we were the ones who are arguing most strongly for....

F: Absolutely not.

T: Well, I'm very glad. This has surprised me.

F: I have disciplined myself severely and constrained myself in order to try and capture this position, unsuccessfully because I find that people won't take my point. You see, this really takes us along what you should do, you have to say: "I have a sufficient understanding of Johnson-Matthey material Type A. I am going to freeze my design on that. I am going to explore the operating condition of J-M Material Type A. It won't be the best, but it's acceptable to lead to a demonstration." And I find myself in conflict with everybody.

T: So you would be very happy with our going public with a working excess energy machine.

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F: Good luck to you.

T: Well, if it doesn't work, I'll be on the phone to you. You can tell me where I'm going wrong.

F: One of the things which was very clear all the way through was that if you followed a certain line of development, which I'll call the Utah branch — the Utah system, you would get to a demonstration, but then the point is why don't people want to do that? The question is: who wants the Utah line to succeed?

T: Well quite, but I would have thought for example that the people at Toyota would see the benefit.

F: They've got their own axes.

T: Yes, but in 1947 the basic idea of making a point-contract transistor was released to the world, and labs all over the world then spent a fair number of years before the very first transistor radio was able to be made. In other words, the thing was out there and everybody was working on it. I would have thought that, for example, Toyota had stuff to sell in demonstration kits, which I think could have been done if the effort had gone in that direction.

F: Well that was very clear. I saw ICARUS I as a stepping stone to a low-cost demo device.

T: Could you define ICARUS?

F: Isoperibolic Calorimetry Research and Utility System. This is the data acquisition system, the whole lab with thermostat tanks and a data acquisition system...a data interpretation system. This was all behind Icarus 1, the thing which went to NHE Labs. I saw this as one of the logical developments, to make a low-cost version of Icarus I which people could play with. And more of my foolishness, more of my follies, yes. As I said, I should have called it Daedalus but I couldn't think of a good acronym for Daedalus.

T: The Wright brothers had their arms twisted into giving a public demonstration, and the gasp from the huge crowd who saw them finally fly was the sound of the paradigm shifting. If Toyota had produced and sold demonstration devices — with a great public press conference announced the sale of the Size 1, Size 2 and Size 3 cold fusion demonstrators, things would have changed.

F: But tell me, what interest would they have in that?

T: Well, I think their longer term interest might have been served, do you not think?

F: No, I don't think so.....Look, if people had said to me how do you develop this thing into a demonstration device, I could tell them. In fact, in '89, when we thought the Select Committee of Congress would come out of Salt Lake City, I dropped everything else in order to try and make a demonstration device, but this is a non-trivial exercise. Very difficult to do. Since then, if people had said to me, "How do you set about making a demonstration device?" I would tell them, but nobody asks me that.

T: But you are happy with our approach, the Ragland cell?

F: Yes, but I have my own view of how I could do it, but I now don't have a budget, so I'm not going to do it. I'd need a lab and I'd need a budget and I haven't got that so I'm not going to do it.

This whole thing started off in 1947 ...when I ran across the papers of Alfred Coehn ...

T: Well, fair enough, but you feel our prospects are good?

F: Well, yes.

T: It doesn't really matter what kind of device it is.

F: There will be a hundred different devices.

T: Yes, exactly, we don't really care. We just want to make sure that one of them gets in front of enough people, so that interest will be then taken.

F: If I'd pursued this as a piece of science, I wouldn't have done the research which I have done.

T: It seems to me that you and our group are much closer in outlook than I had thought we were.

F: I think I discussed with you the question of why we did it and, here, I think again if you are doing the transcript I would put this in. This whole thing started off in 1947 — at the end of 1947 when I ran across the papers of Alfred Coehn — and I realised that there was a very very big problem here the incompatibility of the dissolution of hydrogen as protons in the lattice, and at the same time, the high diffusion coefficient, the high mobility.

The first paper was published in 1929, and in fact Alfred Coehn showed that the hydrogen in the lattice had a unit charge. I knew about the work of Lange on the Galvani potential in the lattice, and the work of Gurney and Butler before the War on interpreting the quantum mechanics of processes at interfaces; and you could stick all this together and come to a conclusion. And at that time there was also a lot of interest in exploding wires and making metal films, so I realised that you could create very strange conditions by applying a field to the wire. But that would have involved rather heroic instrumentation, and I parked it in my head. Then in the early 60's I came to the realisation, as I said to you, that we have a very poor understanding of electrolyte solutions.

So on we go from there, and then I come to the end of the 60's, the beginning of the 70's and realise that the behaviour of the hydrogen in the lattice or, of course, at the interface, can only be understood in terms of many-body effects, so now the whole thing is complete; you know — bang-bang-bang now we can go on — there is enough basis to think that we should go on to explore whether the nuclear cross sections are changed.

Well, I think that was then the point at which I had decided it was worthwhile starting, but I still didn't start it because I was still in full-time employment and I realised that this research was incompatible with being an academic, it was too outrageous. So, in 1983 Stan and I discussed a number of projects — we had room for one more project in Salt Lake and we had several options, I told you one was the behaviour of electrons in metals, one was the strange thing to do with gravitation, and one was cold fusion and there was a spectroscopic one and the spectroscopic one we needed too much money for. In fact, we needed too much money for all the projects except the one on cold fusion. So we decided to do this thing in a rather low level way because we didn't really think it would work, so we had five years of on-off experimentation. But we did actually have four different systems which we defined, which would be interesting, of which the lead one was going to be electro-diffusion; and the reason we did the thing in the particular way in which we did it is a long story.

So then the results were really totally surprising, and we got into all these other subsequent difficulties. The best result in a way would have been if we had found nothing. You know, historically. I think even we would have been happy, but in the end we had enough information which did not fit non-Poisson distributed neutrons, certainly something in the gamma ray spectrum — goodness knows what —we found the correct gamma ray at the end of '89.

T: And does this not bring in the whole question of the moral dimension in science?

F: Well the question is what do you do with a set of results. The publication was

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premature, there's no question about that. Our original protocol called for three independent methods of measuring the excess heat, of which we had only done one, so we did not want to publish until we had three independent measurements with as much confirmation as we could muster. But we even had some indication of helium, you know, but that was unpublishable, not even we could be persuaded to publish that. We needed huge resources for that. I don't think one could have done it in '89 actually.

T: Might you consider the helium to be less the result of fusion, more the result of the stimulation of alpha-emission?

F: Well it could be. You'd always have to budget for that.

T: When I asked about the moral dimension, I was thinking less of how well one is fitting into the protocols of science, I'm talking more of the moral dimension to society as a whole, of the individual scientist confronted with an interesting result. There is a problem, is there not?

F: Well it depends on what sort of person you are. I'm sure that most people with the information which we had in '89 would have suppressed it.

T: For good and sufficient reason.

F: Because it just didn't fit in, they didn't understand it. Unfortunately, I think I understood enough about it to realise it was possible.

T: That it wasn't quite as absurd as it looked.

F: No, because that's how we came in.

T: Because you came in from a concept which was rather more sophisticated a concept than simply shoveling deuterium into a lattice

F: But that's crazy.

T: But people do, as I say, people think of the Wrights as a couple of lucky mechanics.

F: But they were very good engineers.

T: And very good scientists as well.

F: Yes, indeed.

T: Yes but most people see them as a couple of lucky tinkerers and most people see your idea as very naive.

F: This is because they cannot conceive that anybody would ever be able to work something out.

T: Well, I think it's the same reason that Shakespeare can't have written the plays because no glove-maker's son could produce work of such high literary quality.

F: But they don't understand that because they can't do it, that somebody else might.

T: I'm beginning to understand now what you are saying, that you had a vision of solid state — shall we say physics, shall we say chemistry — which included this, and your reasoning for cold fusion was simply as an example of something much more complex.

F: That's true as far as I am concerned, yes.

T: And so the common idea that you were simply thinking in terms of, "Ho, ho, let's squash some deuterium and make it fuse!" is as much of an over-simplification as saying, "Oh, the Wrights were lucky because they happened to have an engine that would pull an airframe."

F: Yes, I have been through this thing before, in a much less extreme way. People have said, "You go in the lab, you fiddle about and get this result and then everybody else finds that you were right, you must have just gone in the lab and fiddled about and got this peculiar result."

Informal interview with Mrs. Sheila Fleischmann

— 8 February 1997

by Susan Seddon

[*Whilst Chris Tinsley was interviewing Prof. Fleischmann, I had the good fortune to be able to chat with Mrs Fleischmann about her experiences as the wife of an eminent, and unjustifiably maligned, scientist. This was an intriguing insight into their life together.*]

The old cliche that behind every successful man is an astonished woman simply does not apply in this case.

Sheila Fleischmann is in no way astonished — or even mildly surprised — that her husband is regarded as one of the world's greatest electrochemists.

We chatted informally in the kitchen of their lovely home, and as neither of us are very technically-orientated, we found the intricacies of cold fusion left us both—quite literally—cold. So we let the "Techies" thrash it out in the lounge while we sipped Earl Grey and discussed more civilised matters.

To my utter astonishment, I discovered that no-one had ever sought Mrs. Fleischmann's views on her husband's work, or their treatment following the notorious Press Conference of 1989. Indeed, Mrs. Fleischmann herself expressed amazement that anyone would find her views of the slightest interest.

I assured her that this was certainly not the case, with regard to our subscribers, and that I felt the "general" press had been severely remiss in not seeking her extremely valid and important recollections of such traumatic past events.

Sheila Flinn and Martin Fleischmann were first introduced to each other, by a mutual friend, when the Professor was 19 years of age and she was some years younger. (I regard a lady's age as restricted information, and too many of you are good at mathematics. This is merely a personal quirk of mine—Mrs. F. was not at all bothered about revealing her age).

They were married in 1950. They have three children, two daughters and a son. They also have seven grandchildren. Their son, the eldest, has two boys, the elder daughter has three girls and the younger daughter has one of each. Their grandchildren range in age from twelve years right down to one.

On the walls of their kitchen are many fine examples of juvenile art. A particularly nice one caught my eye, it was a drawing of the family and was inscribed "To my friend Nana, love Anna." "Nana" and "Poppy" Fleischmann obviously hold a sacred place in the hearts of their grandchildren.

I asked Mrs. Fleischmann whether she sensed, when they first met, that the Professor was, in any way, exceptional. She candidly replied that she was severely impressed that he had gained a First Class Honours degree in two years flat. She also declared him, without hesitation, to be a "genius." This was not mere "wifely pride" but simply a statement of fact on her part.

She believes totally in the credibility of his work and she has that marvellous feminine trait of instinctively being able to see past the technicalities to the wider moral issues behind CF. We discussed how CF cells could change lives, particularly in the Third World, where acquiring the power to provide clean drinking water alone could change lives 100% for the better.

"People are much more important than science," she declared.

At the time of our meeting, Mrs Fleischmann was temporarily wheelchair-bound. She had taken a nasty fall while out walking and had broken her leg. She had lain, undiscovered, for half an hour before her shouts for assistance were heard.

She was very fortunate to have been discovered at all, living—as they do—in a tiny

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hamlet in the wilds of Wiltshire.

To readers unfamiliar with the rigours of our English weather, I must state that lying, badly injured, in ditches here in the depths of winter is not the most salubrious way to while away 30 minutes. Quite categorically, this is one instance where there would be absolutely no manifestation of excess heat.

Mrs. Fleischmann agreed, despite her fractured leg, that she had been very lucky that day.

She is an active, lively and extremely eloquent lady, who is desperately anxious to be back on her feet again. The enforced inactivity does not please her at all. As a highly talented artist, and former teacher of art, she longs to be back standing at her easel.

Mrs. F. related, with great anticipation, how the first trip out following her recovery would be to a London Exhibition of the work of Georges Braque, her favourite artist whose influence is strongly visible in the wonderful examples of her work, many of which adorn the walls of their home.

Her creative talents are not confined to painting, she is also an accomplished potter, and although she has temporarily ceased this latter activity, she intends to re-start when she has more free time.

Mrs. Sheila Fleischmann at home

Even given her obvious preference for painting semi-abstract still life, I ventured to ask whether she had ever attempted a portrait of the Professor.

She hadn't, but thought she might like to, one day. My comment that keeping any scientist still long enough to capture his image on canvas would be a major achievement in itself, was met with a knowing smile.

Our discussion then turned to the time immediately following the 1989 Press Conference and the impact this had on her and their children.

She had, until then, known nothing of the work on which her husband was engaged and the sudden media circus had hit her like a "bolt from the blue."

She described living almost in a state of siege for at least three months following the cold fusion disclosure, with press and T.V. people virtually camping on their doorstep; mail (not all of it congratulatory) arriving by the sackload and of many sleepless nights when the telephone seemed to be permanently ringing. She was, understandably, angry and deeply concerned for the welfare of their children.

That the Professor had not been ready to disclose his results, but had been presented with a *fait accompli*, was obviously a focus for her annoyance. Subsequent accusations of falsification of results [*The famous gamma ray spectrum, indicating neutron emission—as alleged by several anti-cold fusion writers.—Ed.*] did little to quell her irritation with the media, to whom she attributes a hefty proportion of their ill-treatment.

People are more important than science.

"Why would he do it?" she asked. "Why would a respected Fellow of the Royal Society try to pull the bogus stunt the media and others accused him of, especially after such an erstwhile eminent scientific career?"

Her logic was irrefutable....why would he?

"In any case," she continued. "As if he could possibly have got away with it—it's just nonsensical and if it wasn't so sad, it would be laughable!"

Accusations that the "stunt" was for financial gain had made her extremely angry indeed, and she had dismissed these allegations with the contempt they so richly deserved. They had made no profit from this enterprise. They had merely suffered at the hands of the unscrupulous media [*Media egged on and encouraged by "scientists" with "intellectually vested interests."—Ed.*].

Mrs. Fleischmann had obviously played a paramount role in maintaining the family's sanity throughout this very difficult period. Beneath her gentle, easy-going demeanour I detected a very strong-willed and determined lady who, obviously, did not take kindly to this obscene intrusion into their privacy, and justifiably so.

The shock waves of '89 still pervade their lives, albeit at a considerably less intense level. Mrs. F. is clearly regretful of many of the direct and personal effects the furor left in it's wake, some of which may never be resolved. This is a source of great sadness to her, but she has never wavered in her conviction about the validity of her husband's work, and never shall.

The Fleischmann's share many common interests—music and art foremost among them. Mrs. Fleischmann is also actively involved with issues affecting the community, such as raising funds for a nearby Hospice and supporting the activities of a local Conservation Group.

It seems highly unlikely that either of them will ever aspire to total retirement, of any kind.

The swing and slide in the garden stood impatiently awaiting the return of their carefree young masters and mistresses as I know, for sure, do the Fleischmann's themselves.

Editor's Note: The 18th or 19th century stone plaque on the Fleischmann home (*see photo of Martin*) is a saying of St. Austell:

"Let thy life pass, and be thy work well done."

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A Bombshell Techno-thriller... The SAINT

HOLLYWOOD'S FIRST GOOD COLD FUSION MOVIE

EDITOR"S NOTE: Like a "Bolt-Out-of-the Blue," came the request for me to be the technical advisor to *The Saint*, movie, which was about to be produced by Paramount Pictures. It was the spring of 1996. Now the movie is about to debut and I admit to some excitement that it really, finally, is happening! (Yes, I *do* hope the credits list yours truly, at least slightly above Ms. Shue's make-up person!)

The script I was asked to review and critique already had a strong, central cold fusion element—they certainly cast cold fusion in a highly positive light and had absorbed the reality that *Nature* magazine *et al* had inappropriately attacked cold fusion. Fleischmann and Pons were mentioned favorably in the dialogue. But I could see that changes were in order. As an example, I told them not even to *think* about having part of the story unfold at Princeton University—bastion of the hot fusion "tokamak Maffia."They never would have gotten on campus!

I'll leave you with two teasers—samples of dialogue in one version of the script that well might appear in the film. Dr. Russell (Elisabeth Shue) tells a person whom she believes to be an editor of *Nature*:

"Ever since the Pons and Fleischmann debacle, you've tarred everyone in my field as a ripoff artist or escaped mental patient and the snide editorials have made it so f--cking hard for people like me to get even minimal funding."

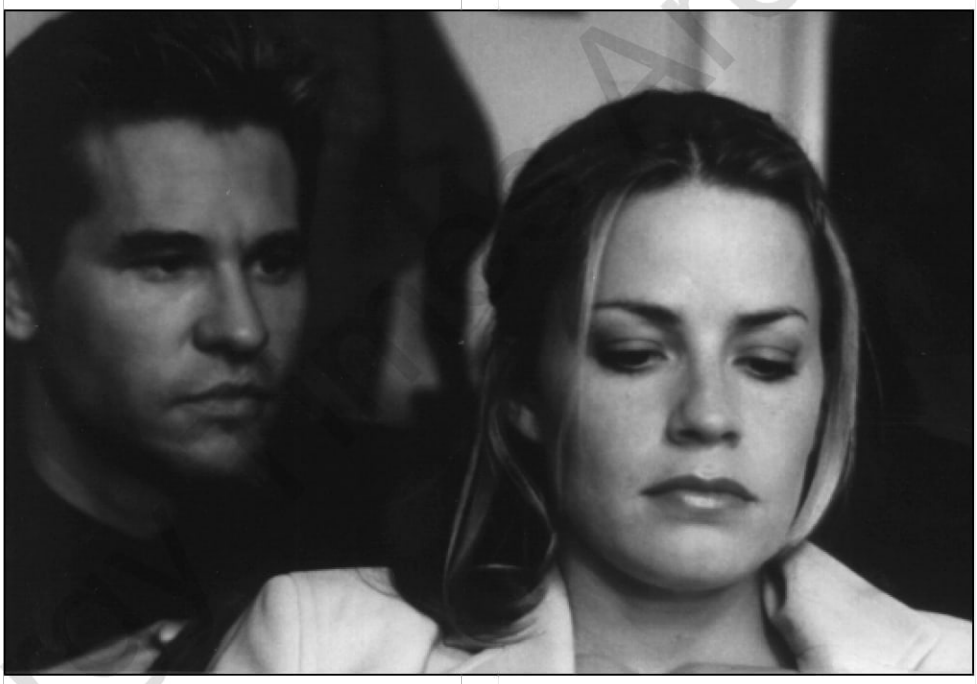
and

"Sure, Cold Fusion's had a difficult childhood, we're orphans, bastards at best...But difficult childhoods make interesting adults, don't you find?" ***—EFM***

March 14, 1997—Nine days before the 8th anniversary of the cold fusion announcement at the University of Utah, Paramount Pictures' box-office techno-thriller, The Saint, opens in theaters across the United States. Paramount released the following information on the movie, without revealing the film's central plot element—the battle for the secret of "the ultimate cold fusion process"....

PRODUCTION INFORMATION

Simon Templar, gentleman and master thief, is equally at home negotiating with power brokers, seducing beautiful women, or dangling from the roof of a ten-story building. A man of a thousand disguises, Templar has eluded international syndicates, corrupt tycoons, and Interpol with equal ease. But he is more than a sophisticated thief. He becomes The Saint, battling for justice where the law cannot or will not reach.



Val Kilmer and Elisabeth Shue star in Paramount Pictures' *"The Saint"*
—Photo by Stephen Morley

THE SAINT, which stars Val Kilmer and Elisabeth Shue, is directed by Phillip Noyce from a screenplay by Jonathan Hensleigh and Wesley Strick and a story by Jonathan Hensleigh. Also starring in the action-adventure is Rade Serbedzija and Valery Nikolaev. Presented by Paramount Pictures and Rysher Entertainment, "The Saint" is produced by David Brown, Robert Evans, William J. Macdonald and Mace Neufeld. The executive producers are Paul Hitchock and Robert S. Baker. Paramount Pictures is part of the entertainment operations of Viacom Inc.

Simon Templar (Val Kilmer) is rich, sophisticated and almost supernaturally skilled at stealing even the most closely guarded of treasures. He is also cold and cynical, until his path crosses that of Emma Russell (Elisabeth Shue), a young scientist whose life is in terrible danger. Emma has discovered the key to Russian billionaire Ivan Tretiak's (Rade Serbedzija) overwhelming ambition — to crown himself the first Czar of the new Russian Empire — and he will do anything to neutralize the danger that she represents.

Stirred by long-dormant feelings, Templar desperately fights to protect Emma while struggling to master the one identity he cannot assume with ease — himself.

Director Phillip Noyce first discovered "The Saint" at the age of eight. A fan of the Roger Moore television series then showing in his native Australia, Noyce went on to read the original novels written by Leslie Charteris. Years later, when producer Robert Evans brought THE SAINT to Paramount, Noyce was given the opportunity to bring a '90s Simon Templar to the big screen. "I wanted to portray how a sinner becomes a saint," says Noyce, "and how someone is redeemed."

For inspiration, Noyce went back to the Leslie Charteris novels. "I realized what we had to do in order to reinvent the Simon Templar character was to tell the story that had never been told — how Simon Templar becomes a saint," Noyce explains. "In his hundreds of stories, the creator of 'The Saint,' Leslie Charteris, had never told us about the genesis of the character."

Noyce enlisted screenwriter Jonathan

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Hensleigh ("Die Hard With a Vengeance") to create a darker Simon Templar. According to Noyce, "we decided Templar's story should begin in an orphanage in Hong Kong where, as a child, he learns all the tricks that he is going to use when he is an adult and how he uses these to survive. He's a man who like a child, retreats from the brutal reality around him by using disguises which are really an escape, a mask hiding the real man."

For the role of Simon Templar, director Noyce chose Val Kilmer. "We didn't need just another action hero; we needed a real actor," says Noyce. "Val Kilmer was the only one who had the true acting ability to play all the diverse parts that Simon Templar has to play. Val has never been used in this way— and I think people are going to be quite surprised with what he comes up with in this movie."

Val Kilmer as Templar in *"The Saint,"* here up to less than saintly deeds, purloins some very hot cold fusion information. — ***Photo by Stephen Morley***

To Val Kilmer, "the excitement of this project is creating a series and an introduction to this character. Templar has a morality and a code and, like many professional thieves, has no interest in harming people or killing them. He is not a bad man; he just grew up in the illegal world and that's what he does for a living." In THE SAINT, Kilmer actually plays over a dozen characters donning Templar's many disguises. Describing how Templar's disguises evolved, Kilmer says: "We started off just goofing around with ideas, seeing how far we could go. It was a lot of fun. At least once a week I'd come on set as someone else." According to producer Mace Neufeld, "Val has been meticulous in developing his disguises. He developed them through body language, attitude, and dialect. His desire for authenticity and accuracy to perfect these disguises made him work very hard in the preparation."

To play opposite Kilmer in the role of scientist Emma Russell, Noyce needed an actress who would be believable as a nuclear scientist. "She has to radiate intelligence," says Noyce. "I have always admired Elisabeth Shue's work and as soon as I saw her in *Leaving Las Vegas*,' I knew I had found my Emma."

For Academy Award nominee Shue, participating in THE SAINT was "a big adventure. I was definitely attracted to the 'big' nature of this movie," she says: "I don't think I have ever done a film this big. Also, the main reason for doing this movie was to work with Val."

Shue's character, Emma Russell, represented a change from characters she has recently portrayed. "It was very freeing to play someone who was free of deep pain and torture," Shue explains. "I was attracted to Emma most of all by her innocence, her spirit, her wonderment. Emma is somebody who has lived in an isolated world." In Shue's view, Simon Templar "represented all that Emma didn't know, and all that she needed to experience in her life."

Much of THE SAINT takes place in contemporary Russia, and director Noyce looked for Russian and Eastern European actors who would bring authenticity to their roles. "We wanted actors that would startle the audience so that they could really believe in the characters," says Noyce. "In Russia, we came up with some fantastic actors."

Valery Nikolaev plays the key role of Ilya, the violent and erratic son of industrialist Tretiak. To Nikolaev, Ilya is — like Simon Templar, in a way — a man driven by his search for his own identity. "Ilya is the son of Ivan Tretiak, a very powerful man," says Nikolaev. "Ilya wants to be more powerful and bigger than his father. He knows that so long as his father is at the top he will always be second." In addition, Russian actress Irina Apeximova plays Frankie, a young Russian woman who befriends Templar.

Rade Serbedzija, a Croatian actor, was cast as Ivan Tretiak, Ilya's father and the would be dictator of Russia. Serbedzija recalls how the role of Tretiak evolved. Phillip Noyce, he says, had this wonderful idea to make him like a Rasputin character. Tretiak was formerly an ordinary Russian government politician, but when times change in Russia he himself changes. He takes on this new image like Rasputin and becomes obsessed by the need for power and domination." In an interesting casting twist, Rade Serbedzija's daughter, Lucija, also appears in THE SAINT. She plays the part of Sofiya, a teenaged Russian girl who hides Templar and Emma from Tretiak's agents.

ABOUT THE PRODUCTION

THE SAINT was filmed on location in Moscow and England, and at Pinewood Studios near London. Principal photography began in Moscow in late March, 1996, and was completed in England in August 1996.

Filming in Moscow and especially in historic Red Square offered exceptional opportunities and challenges to all involved in the production. Months of delicate negotiations were required to obtain permission to film in Red Square, in front of the Kremlin. "Shooting in Red Square is the equivalent of filming on the lawn of the White House," explains producer Mace Neufeld. The shooting schedule for THE SAINT required four twelve-hour night shoots involving two thousand extras in addition to the cast and crew.

"We were very lucky to be working with Nikita Mikhalkov and his Tri Te Studios," says director Noyce. Mikhalkov, who won an Oscar for "Burnt by the Sun," arranged for the authorities to close Red Square for five nights and one day. "The Kremlin surrounded it with troops to keep people out, and we were able to get on with

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our filming," says Noyce. "Moscow was fabulous — the best location filming I have ever experienced."

Shooting in Moscow gives THE SAINT an authenticity unattainable any other way. According to production designer Joseph Nemec, "Russian architecture is quite unique. Classical, but with what I ended up calling the Russian Twist in that everything is pulled or pushed a bit, made a little bit taller. From a learning standpoint that was very exciting."

The challenges of filming in Russia included working in a young democracy — a country still in the midst of rapid change, and unaccustomed to Hollywood filmmaking. Russian production crews lack modern equipment, and organizational structure was often lacking. "There were lots of people willing to work" says Nemec, "but no decision makers, so that made it very difficult." The differences in atmosphere between Russia and England contributed to the look of the film. "In broad-brush terms," Nemec explains, "Russia was the darker country and England, the lighter. There is a harshness that exists in Russian life and climate that we tried to personify as opposed to the more genteel approach of the scenes in England."

A key scene in THE SAINT features a mass demonstration that takes place in Red Square in front of the Kremlin. Getting the right look for the demonstration proved to be challenge in production design. "One thing interesting that I learned," said Nemec, "was trying to give it the look of an authentic Russian demonstration. Something didn't seem right. In studying it, we realized what it was — in all Russian demonstrations there is one color, red. The new Russian flag is three colored, and Tretiak is trying to be sympathetic to both ends of the political world there." A small change made a big difference in the feel of the scene, explains Nemec: "Even though our size of flags and our scope and scale were right, having three colors rather than one made that difference."

Rade Serbedzija, who plays industrialist Ivan Tretiak, describes the experience of filming in Red Square. "In a way Red Square seemed untouchable. Yet there we were, this big group of filmmakers shooting our movie, filming two hundred meters from Boris Yeltsin's office. It was an extraordinary experience and seemed dominated by director Phillip Noyce. He seemed like a magician with his amazing energy which cut through the terrible cold, energizing everybody and making it happen."

For director of photography Phil Meheux, the challenge was how to

light Red Square which is the size of four city blocks. Red Square is a national monument; it belongs to the people, says Meheux. "The challenge was being only able to light from one direction, because there was only one building where the roof was conducive to rigging. All the others were ancient buildings. I had to work out how that lighting would work from one side and still give us all the variations you need with all the different cameras and all the effect shots."

In a key sequence of the film, Emma Russell escapes from Tretiak's agents by taking refuge in the American Embassy. However, the actual American Embassy in Moscow is on a cramped side street amid nondescript buildings. According to Noyce,"it was not at all what we had in mind for one of the movie's most exciting sequences. To capture the scale of Emma's desperate flight, we needed a big setting."

Production designer Nemec set out to find one. "We looked for an area that seemed to symbolize Russian architecture and have a lot of statues around," says Nemec. His decision was to use the Peking Hotel. "We covered up the Communist insignia and took away all the Chinese lettering, put up a gate and the flag, and we had our embassy."

For some of the Russian scenes, however, the ideal locations were found in England. For the interior of the Kremlin, Nemec used the Pearl building in London, which proved to have a strikingly Russian feel to it. "What was unique about the Pearl was that it was a 1920's building. It had different kinds of spaces and it was easy to take it into a Russian look," says Nemec. "It had a lot of white marble and birch wood, two very common Russian materials. The old banking lobby which we used as a Russian hotel lobby had the right kind of pink marble paper. There were many opportunities to take an environment into a certain direction and make it correct without having to build the whole thing on a stage."

Most location shooting in England took place in and around Oxford, home of England's 800-year-old Oxford University. Among the Oxford locations used in the film were the Radcliffe Camera — a large domed building built between 1737 and 1749 and now used as a reading room for Oxford undergraduates. In the film, it plays the part of the University's famed Sheldonian Theatre. Oxford's Inorganic Chemistry Laboratory was used as Emma Russell's lab and offices; and a meeting between Emma and Templar was filmed at the Shelley Memorial, built in honor of poet Percy Shelley and located in Oxford's University College. Other English locations included the Harrow, famed boys' school which was used for the interiors of the Sheldonian Theatre. The Caverns at Fort Amhurst doubled as the Kremlin tunnels, and Borocourt Hospital served as the orphanage where sequences from Templar's childhood were filmed.

One key studio set was built in Russia. This was the exterior of the Tretiak mansion — a project that prompted much curiosity among Russians. Letters to Russian newspapers demanded to know why a large palatial building was going up on a site surrounded by guards. Then the news got out: Hollywood was coming to Russia.

Most studio shooting took place at Pinewood Studios near London, where interiors were built for many of the Russian sequences. Among the sets at Pinewood were Professor Botvin's laboratory, Ilya's bedroom, Templar's hotel room, and, outstandingly, the interior of the Tretiak mansion. Built in one of Pinewood's largest sound stages, the Tretiak mansion interior was a palatial structure of marble and gold, two and a half stories high, incorporating a domed roof and immense chandelier. "It's a real set construction design," says production designer Nemec — and one that provided a spectacular setting for the climactic battle between Simon Templar and archvillain Ilya Tretiak.

The Tretiak mansion is under mortar attack as Templar and Ilya confront one another. This sequence called for close work between special-effects coordinator George Gibbs and stunt coordinator Gregg Powell. "We had a lot of high explosives and flames," says Gibbs, explaining the potential hazards of his work. "Explosives always go their own way; fire will always search for oxygen."

Moreover, explains Gibbs, "when we tried out the effects for the mansion sequence, the set hadn't been built yet." Thus, he and his special-effects team had to calculate flammable gas and explosive requirements sight-

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unseen. "It was a real challenge," admits Gibbs, "because the whole set is made of plywood and timber, and we have a vast amount of fire going on. The risk factor was that we always had to have the floor alight. This was done with planks of steel with the fire coming through the gaps. These were replaced with wooden planks when the chandelier comes crashing down."

The special-effects coordinator has to build a strong rapport with the actors who will perform amid fire and explosions. "I hadn't worked with Val before," says Gibbs, "but Gregg Powell, the stunt coordinator had, so the three of us bonded and worked together with complete confidence. We had two weeks of collapsing towers, fireballs, and blowing up walls, and no one was even scorched. It's a great achievement. It's wonderful when the stunt guys come up to you afterwards, shake your hand, and say 'real cool!'"

Stunt coordinator Gregg Powell had previously worked with Val Kilmer on the film "Willow." He was also familiar with Russia, where he worked on "Sharpe," a popular British television series.

For THE SAINT, key stunt work included the mortar attack on Tretiak's mansion, an exploding Range Rover, and Simon Templar free-falling from a ten-story building — as well as the climactic battle on a chandelier suspended above a blazing inferno. Powell, whose recent credits include "First Knight" and "Michael Collins," began working as a stunt performer fifteen years ago. "With that experience and learning those skills," he says, "I then became an advisor to others. I would never ask a stunt performer to do anything I haven't done myself."

"We worked with a nucleus of twenty Russian stuntmen," Powell explains. "When I knew we were doing stunts in Moscow, I contacted many that I had worked with on the television series. With stuntmen around the world you don't have to speak the same language — they instinctively know what you are asking of them and what you are trying to achieve. The stunt equipment they use may not be on a par with what we use in Britain and the US, but their stunt work cannot be faulted. They get the same effect. They're a great bunch of guys."

At the heart of THE SAINT are the many faces of Simon Templar. In creating his disguises, Val Kilmer worked closely with costume designer Marlene Stewart and chief makeup artist Paul Engelen. According to Stewart, "a lot of the disguises evolved in the process of evaluation — Val working with his dialogue coach and finding an accent which was the key to each transformation."

In the course of the film, Templar adopts disguises ranging from a Russian bodyguard to an Oxford artist and more. In one sequence, Templar is clad in a special thermal suit that enables him to slip unnoticed past laser detectors. Costume designer Stewart began with research into the actual thermal suits worn by astronauts. "They were not exactly figure enhancing, but we took that idea and streamlined it. Val also had special head gear and laser goggles which he had to be able to take off easily."

Kilmer and Shue huddle in Moscow crowd in a scene from "The Saint"

Photo by Stephen Morley

In another sequence, says Stewart, Templar "plays a South American business man with a distinct accent. He has long hair and is quite elegant -- I guess you would call this his seduction disguise. He looks very fashionable and handsome." All of Templar's disguises had to be "interesting, entertaining, and believable, yet still a bit of a fantasy," Stewart explains. But in Simon Templar's deadly business there is no place for whimsy. "The disguises have to be totally functional and rooted in reality."

According to chief makeup artist Engelen, designing Templar's disguises "was an ambitious thing to do, but it was also fascinating finding out what could be achieved." Engelen describes the process of working out the disguises: "We started by taking a series of photographs and everything evolved from there. Val has a strong face, defined lips, and strong brow. But once you tone the lips and narrow the shape of the face and head, you can get away with a lot. Then, as Val becomes the character, he develops a different posture, throws his expression a little, and the whole thing takes shape. What was quite daunting from the outset turned out to be great fun."

"Creating the look of Simon Templar was very challenging?" says costume designer Stewart.

"At all times he looks the handsome hero, his own clothes are streamlined but efficient; they don't tell you who he is. Templar is an empty palette who adopts these layers that become his disguises."

Stewart also designed the style of Emma Russell. "Her character evokes an echo of Templar's past," Stewart explains, "so we have her originally dressed in a kind of schoolgirl way, although her lab coat reminds us of her work area. As the story progresses and she meets Simon Templar, a romantic element enters. She becomes less restricted and a bit freer; her clothes are less severe and she has a softer look."

Turning to the villains of the piece, Stewart saw no place in today's Russia for the boxy cardboard-like suits of the Soviet era. Billionaire Ivan Tretiak wears the contemporary Russian power suit, while his son Ilya and his henchmen have a fashionable '60s gangster look. "They are Russian street boys and have very sharp suits," explains Stewart. "They are sophisticated and sleek in a very dark way."

As a contemporary master thief Simon Templar is as much at home hacking the Internet as cracking a safe. According to Andrew Eio, computer and video effects supervisor, "We knew Simon Templar was quite a technical sort of person and that he would have a sophisticated system." Eio faced the challenge of creating computer graphics and effects that would be dynamic and exciting, while carrying forward the plot of the film. "We wanted to create an environment that was realistic with an interface that would look and feel correct," Eio explains, "rather than have lots of large text that tells the story but doesn't really blend with what is being played upon."

A special challenge faced by Eio and his team was coping with the breathtaking rate of progress in the computer industry. The most advanced soft-

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ware on the market when THE SAINT was in production might already be outdated before the film's release date. "Computer ware goes out of date very quickly," explains Eio. "We made agreements with Apple Computer to have access to software and hardware not yet available, to help us have a look and feel that would be correct for when the film is released."

THE HISTORY OF THE SAINT

Readers and viewers have thrilled to the adventures of The Saint for nearly seventy years. British author Leslie Charteris first created the character of Simon Templar, The Saint, in the story "Meet the Tiger," published in 1928. By 1936, Simon Templar had become so popular that Charteris organized a Saint Club for his fans. Dues from the club were used to fund a hospital ward and later a youth center in London.

The Saint came to the movies in 1938, in a series produced by RKO studios. Templar was portrayed by several actors, most notably George Sanders, who starred in "The Saint Strikes Back," "The Saint in London, " "The Saint's Double Trouble," "The Saint Takes Over," and "The Saint in Palm Springs."

A new generation of fans was introduced to The Saint in the '60s, when Roger Moore took the wheel of his Volvo in a highly successful British television series that has been seen around the world.

Through all these years, author Charteris continued The Saint's adventures in print. Over the decades, he wrote more than fifty novels about The Saint, as well as scores of short stories. In 1992, the Crime Writers' Association honored Charteris with the Diamond Dagger Award for a career of outstanding merit. He died in 1993.

Leslie Charteris never wrote of Simon Templar's origins or how he became The Saint. For the film, THE SAINT, director Noyce and screenwriters Jonathan Hensleigh and Wesley Strick worked out a background based on clues provided by Simon Templar's evocative name. His first name was derived from Simon Magus, the Biblical magician who attempted to buy the powers of the Holy Spirit.

His last name, Templar, comes from an order of crusading warrior monks in the Middle Ages. The Templars were suppressed as heretics in a cynical move orchestrated by rival churchmen and the king of France, who wanted to seize the order's accumulated treasures. The Masonic youth group, DeMolay, is named for the last Grand Master of the Templars, Jacques de Molay, who was burned at the stake in the year 1314.

Suave and sophisticated, magician, thief, battler for justice — all are elements in the makeup of Simon Templar, the classic action hero of the 20th century, brought to the big screen in THE SAINT.

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VAL KILMER (Simon Templar) most recently starred in "The Ghost and The Darkness," costarring Michael Doug-las for Constellation Films and Paramount Pictures. In addition, Kilmer just completed the voice of the title role of Moses in Dreamworks' first animated feature, "Prince of Egypt." Kilmer starred in "Batman Forever" as billionaire Bruce Wayne and his nocturnal alterego, Batman. Kilmer's other noted portrayals include Elm Morrison in "The Doors," Elvis Presley in "True Romance," Doc Holiday in "Tombstone" and Billy the Kid in TNT's "Gore Vidal's Billy the Kid." He recently starred with Robert DeNiro and Al Pacino in "Heat," and appeared opposite Marion Brando in "The Island of Dr. Moreau."

Kilmer drew widespread attention for his role as "Iceman" opposite Tom Cruise in the hit film "Top Gun." His feature film debut was as an Elvis-like singer in the 1984 comedy "Top Secret," followed by "Real Genius" and "Willow." He starred as FBI agent Ray Levoy in "Thunderheart" and appeared in the 3-D epic "Wings of Courage."

On television, Kilmer won a Cable ACE Award for his starring performance in the highly acclaimed HBO movie, "The Man Who Broke 1,000 Chains." He has also appeared in the TNT production of "Murders in the Rue Morgue."

At age seventeen, Val Kilmer was the youngest student ever admitted to the drama department of the famed Juilliard School in New York. As a student at Juilliard he co-wrote and performed in "How It All Began," about a West German radical. Joe Papp of New York's Public Theater was so impressed by the production that he brought it to his theater, where Kilmer made his professional debut. He has also appeared on the stage in Shakespeare's "Henry IV, Part 1," and played the lead roles in "Hamlet" and "As You Like It," starring in the latter opposite Patty Lupone. He made his Broadway debut in the 1983 production of "Slab Boys" with Sean Penn and Kevin Bacon.

ELISABETH SHUE (Dr. Emma Russell) received both Oscar and Golden Globe nominations for her starring role in "Leaving Las Vegas." Shue has also played opposite Robert Downey, Jr. in "Heart and Souls," and earned rave reviews for her performance in "Twenty Bucks." She has also appeared in "The Trigger Effect" and "Radio Inside," among other films.

Not satisfied with formula roles, Shue accepted a smaller supporting role in Steven Soderbergh's "The Underneath" because of the opportunity to play opposite Soderbergh.

Born in Wilmington, Delaware, Shue grew up in a close-knit family, the only sister among three brothers. She enrolled in Wellesley, planning to become a lawyer, but landed roles in commercials to pay her college expenses. This in turn led to her film debut in the critically acclaimed "Call to Glory." She subsequently appeared in "Adventures in Babysitting," "Cocktail," with Tom Cruise, and "Soapdish," with Sally Field and Kevin Kline.

Shue made her Broadway debut three years ago, winning rave reviews for her performance in "Some Americans Abroad" at Lincoln Center. She has also appeared in "Birth and After Birth" by Tina Howe, which led her to participate in the development of a new theater group, The Cooperative.

RADE SERBEDZIJA (Ivan Tretiak) has starred in over forty films produced by all the major studios in the republics of the former Yugoslavia. He twice won the Golden Arena award as Best Actor in the Pula Film Festival. His recent international film credits include "Broken English" and "Before the Rain;" the latter won the Golden Lion at the Venice Film Festival, and Serbedzija was given the Critics Aware for Best Actor for his performance in that film.

A leading stage actor, he has been called the definitive Hamlet of his generation on the Yugoslavian stage. Serbedzija co-founded the KPGT Theater, and toured Australia with the company in 1980, where he won the SAMMY Best Actor Award in the starring role in "The Liberation of Skopje." In 1982 the company toured the United States, where the same play received the Village Voice OBI Award.

A native of Bunic, Croatia, where he was born in 1946, Rade Serbedzija is married to theater director Lenka Udovicki. They have four children, including their daughter Lucija, who co-stars in THE SAINT in the role of Sofiya.

PHILLIP NOYCE (Director), a native of Australia, caught the attention of Hollywood for his work on the highly praised thriller "Dead Calm," starring Nicole Kidman, Sam Neill, and Billy Zane. He went on to direct Harrison Ford as Jack Ryan in "Patriot Games," based on the Tom Clancy novel, and the psychosexual thriller "Sliver," starring Sharon Stone. He then rejoined Harrison Ford, directing "Clear and Present Danger," also based on a Clancy novel.

Born in New South Wales, Noyce moved to Sydney with his family at the age of twelve. There he became interested in filmmaking, and made his first film, the 15-minute "Better Reign in Hell" when he was seventeen. He financed this film by selling roles in the movie to his friends.

In 1973, he attended the inaugural year of the Australian National Film School, and as a student directed "Castor and Pollux," which won the award for best Australian short film of the year. He subsequently co-wrote and directed "Newsfront," winning Australian awards for Best Film, Best Director, and Best Original Screenplay. His next film, "Heatwave," starring Judy Davis, was selected for screening at the Cannes Film Festival.

DAVID BROWN (Producer), in partnership with Richard D. Zanuck has produced some of the most memorable films of recent years, including "Jaws," Academy Award winner "The Sting," the Academy Award nominated film, "The Verdict" and "The Sugarland Express," which launched the directing career of Steven Spielberg in major films. In 1991, the Academy of Motion Picture Arts and Sciences presented the Irving G. Thalberg Award to Brown and Richard Zanuck an award given only twenty-seven times in the Academy's 65-year history. In 1995 they received the David O. Selznick Lifetime Achievement Award from the Producers Guild of America.

In recent years, Brown has produced the acclaimed Robert Altman film, "The Player," and Rob Reiner's Academy Award nominee "A Few Good Men," starring Tom Cruise, Jack Nicholson, and Demi Moore. He executive produced the Academy Awards winning "Driving Miss Daisy." In television, he and William S. Gilmore produced the award-winning HBO series, "Women and Men."

David Brown has also had a long career as a journalist, author, and editor. A New York resident, Brown is a member of the Advisory Board of the Museum of Modem Art, and of the Board of Visitors for Columbia University's Graduate School of Journalism.

ROBERT EVANS (Producer) was named worldwide head of production at Paramount Pictures at the age of twenty-four and served in that position for ten years. Since his recent return to the studio as an independent producer, he has brought to the screen "The Phantom," and the thrillers "Jade" and "Sliver." Among the films produced during Mr. Evans' tenure as worldwide head of production at Paramount were "Rosemary's Baby," "The Odd Couple," "Romeo and Juliet," "Goodbye Columbus," "True Grit," "Love Story," "Lady Sings the Blues," "Harold and Maude," "The Godfather," "The Godfather, Part II," "The Longest Yard," and "The Great Gatsby."

When Mr. Evans returned to the ranks of independent producer, his credits included "Chinatown," which received eleven Academy Awards nominations, "Marathon Man," "Black Sunday," "The Two Jakes," "Popeye" and "Urban Cowboy." Two of his films ("The Godfather" and "Chinatown") were recently selected by the Library of Congress for the National Film Registry.

Robert Evans began his career as a screen actor, a career he chronicled in his international best-selling autobiography, "The Kid Stays in the Picture" (a remark credited to Darryl F. Zanuck who insisted Evans play the bullfighter opposite Ava Gardner in the film adaptation of Ernest Hemingway's "The Sun Also Rises").

He is the recipient of many worldwide humanitarian and industry awards, including the Key to the City of New York, an honor usually bestowed on heads of state.

WILLIAM J. MACDONALD (Producer) has recently produced "Teddy Roosevelt and the Rough Riders," starring Tom Berenger and Sam Elliott, directed by John Milius. Slated for April '97 is Orion Pictures' "One Man's Hero," starring Tom

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Berenger.

Bill is developing and producing "Elvis & Leon" with Affinity Entertainment Group, Inc., Scott Free's "Lucky Strike" directed by Ridley Scott and the classic novel *Atlas Shrugged* by Ayn Rand together with producing partner Craig Anderson.

His other credits include: Executive Producer of "Jade," starring David Caruso, Linda Fiorentino and Chaz Palminteri, Co-producer "Sliver" with Sharon Stone, Tom Berenger and William Baldwin, Producer of "An Occasional Hell," starring Tom Berenger, Robert Davi and Valeria Golino for HBO/Initial Entertainment Group. Bill served as a company producer on "The Two Jakes," "The Burning Secret," "Buster" and "Siesta."

MACE NEUFELD (Producer) began his producing career in 1976 with "The Omen," starring Gregory Peck and Lee Remick He subsequently produced two further films in the "Omen" series, along with "The Frisco Kid" and the critically acclaimed "No Way Out," starring Kevin Costner and Gene Hackman.

In 1989, Neufeld produced "The Hunt For Red October," for Paramount Pictures. Later that year, he teamed up with Robert G. Rehme to form Neufeld/Rehme productions, in an exclusive feature film production deal with Paramount Pictures. Their films have included "Flight of the Intruder" and "Necessary Roughness." Working with Phillip Noyce, who directs THE SAINT, Neufeld has produced two films based on Tom Clancy novels, "Patriot Games" and "Clear and Present Danger," both starring Harrison Ford.

A native of New York City, Neufeld achieved national recognition as a photographer, winning ten awards, including the Grand Prize, in Eastman Kodak's first National Salon of Photography. His 1944 photograph of a returning war veteran, "Sammy's Home," was voted Picture of the Year by the New York World Telegram-Sun. He subsequently wrote and produced for the stage, before moving into television and film production. Neufeld is currently a member of the Executive Committee Board of Trustees of the American Film Institute, ASCAP, and the Motion Picture Academy.

PHIL MEHEUX, B.S.C. (Director of Photography) launched his career shooting major feature films with "The Long Good Friday," starring Bob Hoskins and Helen Mirren. His subsequent feature credits include "Highlander II," "Renegades," "Max Headroom — The Original Story," and "The Honorary Consul," as well as the additional photography for the award-winning "The Killing Fields."

Meheux began his career as a studio projectionist for the BBC, and made his debut as a cameraman on "All My Loving," a documentary about modem music. He later shot eighteen full-length documentaries for the celebrated television series "Man Alive." In 1975, his work on "Just Another Saturday" won the Italia Prize, and another BBC project, "Spend, Spend, Spend" won the BAFTA award for Best Single Play of 1977.

After twelve years with the BBC, Meheux shot his first 35mm film, "Black Joy," produced by Martin Campbell. He has subsequently been cameraman on all films directed by Campbell, including "Criminal Law," Defenseless," "No Escape," and the James Bond picture, "Goldeneye."

Experiment Confirms Zero Point Energy; Patent Issued to Air Force Scientist

by Eugene Mallove

Not that it was a big surprise to those in the New Energy field, but it is *wonderful* that the existence of zero point energy—the potential source of limitless energy for civilization—has now been confirmed in a seminal experiment—one that has already been acclaimed by the scientific mainstream. Of course, the "mainstream" talks of its implications for cosmology and for its "proof" of the theory of Quantum Electrodynamics (QED)—*not* for technological applications.

Physicist Steven K. Lamoreaux, now of Los Alamos National Laboratory, performed an exacting, elegant experiment (while at the University of Washington in Seattle), which confirms within 5% the theoretical formula for the Casimir force, which was proposed in 1948. This is the force that is said to be due to "virtual photons" popping in and out of existence in the vacuum of space. Specifically, it is the force that appears prominently when physical objects are in very close proximity. Then, the tiny region between two objects—such as two closely spaced flat plates—excludes the longer wavelength spectrum of electromagnetic radiation that pervades space. So there is an inward pressure that creates the Casimir force. (see R.L. Forward's tutorial article on ZPE in *IE* #9 pp.53-64)

The Lamoreaux paper, "Demonstration of the Casimir Force in the 0.6 to 6 μm Range," appeared in *Physical Review Letters*, 6 January 1997, Vol.78, No.1, pp.5-8. The abstract is succinct: "The vacuum stress between closely spaced conducting surfaces, due to the modification of the zero-point fluctuations of the electromagnetic field, has been conclusively demonstrated. The measurement employed an electromechanical system based on a torsion pendulum. Agreement with theory at the level of 5% is obtained."

The actual experiment employed a *spherical*-shaped gold-coated plate in near-contact with a flat plate—facilitating precise electromechanical adjustments to measure the forces, which would have been more difficult with two flat plates. The Casimir force formula was verified down to a separation distance of 0.6 μm.

The response to this experiment has been noteworthy. Writing in *Nature*, science writer Charles Seife began: "There is no such thing as a free lunch—except in quantum mechanics. Classical physics—and common sense—dictates that the vacuum is devoid not only of matter but of energy. But quantum mechanics often seems to depart from common sense." It would have been nice had this comment led in the article into the potential technological implications of the experiment, but alas, no! Seife quoted University of Sussex physicist, Malcolm Boshier: "This is one of those experiments that is going to wind up in all of the textbooks."

Malcolm W. Brown's story in the *New York Times* (January 21, 1997, C.1, C.6), was titled, "Physicists Confirm the Power of Nothing, Measuring Force of Quantum 'Foam'" However, Mr. Brown, as usual, ignored the technological implications in favor of outlandish concepts having to do with theoretical cosmology. First off his pen was, "....something might cause the present day universal vacuum to collapse into a different vacuum of lower energy. The effect, propagating at the speed of light, would be the annihilation of all matter in the universe. There would be no warning for humankind; the earth and all its inhabitants would simply cease to exist at the instant the collapsing vacuum reached the planet." Brown quoted cosmologist Dr. Michael Turner of Fermilab: "The energy of the vacuum remains one of the deep mysteries of science. We know from quantum mechanics that it is not empty. We have much to learn." Indeed! Strangely, these cosmology-obsessed people (I confess, I used to be one of them!) do not even think of the implications for over-unity devices.

Fortunately, others have been thinking of such devices. Air Force scientist Franklin B. Meade, Jr. and his colleague Jack Nachamkin have just been awarded a U.S. patent (#5,590,031) for a device to capture zero-point radiation. It employs the novel approach of capturing the beat-frequency radiation of zero point radiation frequencies. The patent, a highly significant one, is reproduced on the following pages. Note the key connection to the Lamoreaux experiment in these words from the patent abstract: "A system is disclosed for converting high frequency zero point electromagnetic radiation energy to electrical energy. The system includes a pair of dielectric structures which are positioned proximal to each other and which receive incident zero point electromagnetic radiation. The volumetric sizes of the structures are selected so that they resonate at a frequency of the incident radiation. The volumetric sizes of the structures are also slightly different so that the secondary radiation emitted therefrom at resonance

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United States Patent
Mead, Jr. et al.

Patent Number: 5,590,031
Date of Patent: Dec. 31,1996

SYSTEM FOR CONVERTING ELECTROMAGNETIC RADIATION ENERGY TO ELECTRICAL ENERGY

Inventors: Franklin B. Mead, Jr., 44536 Avenida Del Sol, Lancaster, Calif. 93535; Jack Nachamkin, 12314 Teri Dr., Poway, Calif. 92064

Appl. No.: 281,271
Filed Jul. 27, 1994

Int Cl.[6].....H02M 1100
U.S. Cl.....363/8; 363/178; 342/6
Field of Search.....363/8, 13, 178; 342/6, 61, 73, 173, 175

References Cited
U.S. PATENT DOCUMENTS

3,882,503	5/1975	Gamara	343/100 R
4,725,847	2/1988	Poirier	343/840
5,008,677	4/1991	Trigon et al	342/17

Primary Examiner—Peter S. Wong
Assistant Examiner—Adolf Berhane
Attorney, Agent, or Firm—Chris Papageorge

ABSTRACT

A system is disclosed for converting high frequency zero point electromagnetic radiation energy to electrical energy. The system includes a pair of dielectric structures which are positioned proximal to each other and which receive incident zero point electromagnetic radiation. The volumetric sizes of the structures are selected so that they resonate at a frequency of the incident radiation. The volumetric sizes of the structures are also slightly different so that the secondary radiation emitted therefrom at resonance interfere with each other producing a beat frequency radiation which is at a much lower frequency than that of the incident radiation and which is amenable to conversion to electrical energy. An antenna receives the beat frequency radiation. The beat frequency radiation from the antenna is transmitted to a convertor via a conductor or waveguide and converted to electrical energy having a desired voltage and waveform.

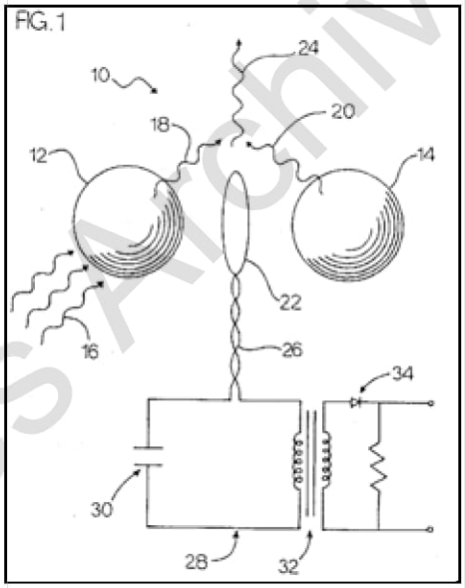
14 Claims, 8 Drawing Sheets

SYSTEM FOR CONVERTING ELECTROMAGNETIC RADIATION ENERGY TO ELECTRICAL ENERGY

BACKGROUND OF THE INVENTION

The invention relates generally to conversion of electromagnetic radiation energy to electrical energy, and, more particularly, to conversion of high frequency bandwidths of the spectrum of a type of radiation known as zero point electromagnetic radiation to electrical energy.

The existence of zero point electromagnetic radiation was discovered in 1958 by the Dutch physicist M. J. Sparnaay. Mr. Sparnaay continued the experiments carried out by Hendrik B. G. Casimir in 1948 which showed the existence of a force between two uncharged parallel plates which arose from electromagnetic radiation surrounding the plates in a vacuum. Mr. Sparnaay discovered that the forces acting on the plates arose from not only thermal radiation but also from another type of radiation now known as classical electromagnetic zero point radiation. Mr. Sparnaay determined that not only did the zero point electromagnetic radiation exist in a vacuum but also that it persisted even at a temperature of absolute zero. Because it exists in a vacuum, zero point radiation is homogeneous and isotropic as well as ubiquitous. In addition, since zero point radiation is also invariant with respect to Lorentz transformation, the zero point radiation spectrum has the characteristic that the intensity of the radiation at any frequency is proportional to the cube of that frequency. Consequently, the intensity of the radiation increases without limit as the frequency increases resulting in an infinite energy density for the radiation spectrum. With the introduction of the zero point radiation into the classical electron theory, a vacuum at a temperature of absolute zero is no longer considered empty of all electromagnetic fields. Instead, the vacuum is now considered as filed with randomly fluctuating fields having the zero point radiation spectrum. The special characteristics of the zero point radiation which are that it has a virtually infinite energy density and that it is ubiquitous (even present in outer space) make it very desirable as an energy source. However, because high energy densities exist at very high radiation frequencies and because conventional methods are only able to convert or extract



energy effectively or efficiently only at lower frequencies at which zero point radiation has relatively low energy densities, effectively tapping this energy source has been believed to be unavailable using conventional techniques for converting electromagnetic energy to electrical or other forms of easily useable energy. Consequently, zero point electromagnetic radiation energy which may potentially be used to power interplanetary craft as well as provide for society's other needs has remained unharnessed.

There are many types of prior art systems which use a plurality of antennas to receive electromagnetic radiation and provide an electrical output therefrom. An example of such a prior art system is disclosed in U.S. Pat. No. 3,882,503 to Gamara. The Gamara system has two antenna structures which work in tandem and which oscillate by means of a motor operatively attached thereto in order to modulate the radiation reflected from the antenna surfaces. The reflecting surfaces of the antennas are also separated by a distance equal to a quarter wavelength of the incident radiation. However, the Gamara system does not convert the incident radiation to electrical current for the purpose of converting the incident electromagnetic radiation to another form of readily useable energy. In addition, the relatively large size of the Gamara system components make it unable to resonate at and

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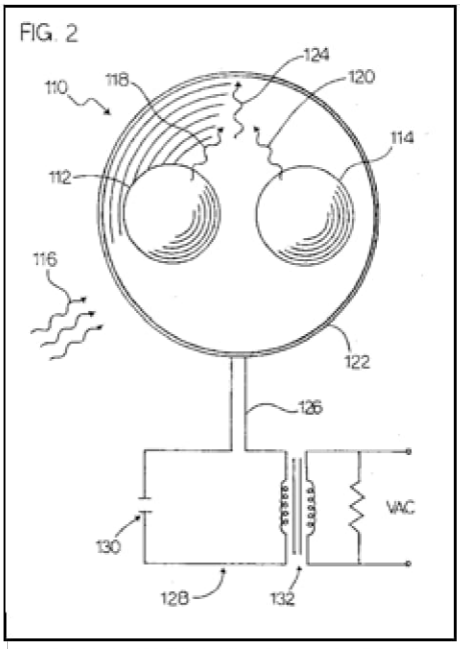
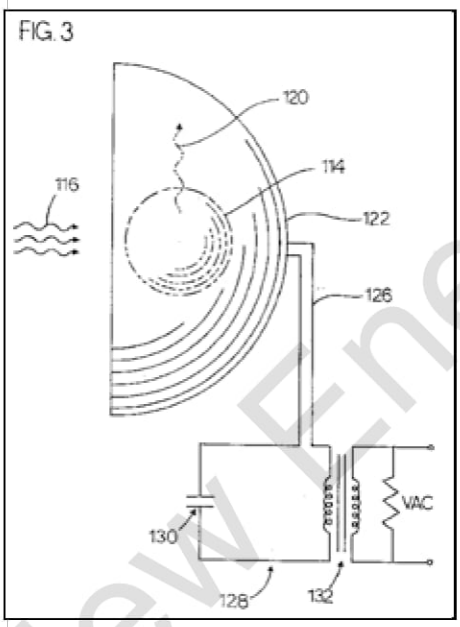


modulate very high frequency radiation.

What is therefore needed is a system which is capable of converting high frequency electromagnetic radiation energy into another form of energy which can be more readily used to provide power for transportation, heating, cooling as well as various other needs of society. What is also needed is such a system which may be used to provide energy from any location on earth or in space.



SUMMARY OF THE INVENTION

It is a principle object of the present invention to provide a system for converting electromagnetic radiation energy to electrical energy.

It is another object of the present invention to provide a system for converting electromagnetic radiation energy having a high frequency to electrical energy.

It is another object of the present invention to provide a system for converting zero point electromagnetic radiation energy to electrical energy.

It is another object of the present invention to provide a system for converting electromagnetic radiation energy to electrical energy which may used to provide such energy from any desired location on earth or in space.

It is another object of the present invention to provide a system for converting electromagnetic radiation energy to electrical energy having a desired waveform and voltage.

It is an object of the present invention to provide a miniaturized system for converting electromagnetic radiation energy to electrical energy in order to enhance effective utilization of high energy densities of the electromagnetic radiation.

It is an object of the present invention to provide a system for converting electromagnetic radiation energy to electrical energy which is simple in construction for cost effectiveness and reliability of operation.

Essentially, the system of the present invention utilizes a pair of structures for receiving incident electromagnetic radiation which may be propagating through a vacuum or any other medium in which the receiving structures may be suitably located. The system of the present invention is specifically designed to convert the energy of zero point electromagnetic radiation; however, it may also be used to convert the energy of other types of electromagnetic radiation. The receiving structures are preferably composed of dielectric material in order to diffract and scatter the incident electromagnetic radiation. In addition, the receiving structures are of a volumetric size selected to enable the structures to resonate at a high frequency of the incident electromagnetic radiation based on the parameters of frequency of the incident radiation and propagation characteristics of the medium and of the receiving structures. Since zero point radiation has the characteristic that its energy density increases as its frequency increases, greater amounts of electromagnetic energy are available at higher frequencies. Consequently, the size of the structures are preferably miniaturized in order to produce greater amounts of energy from a system located within a space or area of a given size. In this regard, the smaller the size of the receiving structures, the greater the amount of energy that can be produced by the system of the present invention.

At resonance, electromagnetically induced material deformations of the receiving structures produce secondary fields of electromagnetic energy therefrom which may have evanescent energy densities several times that of the incident radiation. The structures are of different sizes so that the secondary fields arising therefrom are of different frequencies. The difference in volumetric size is very small so that interference between the two emitted radiation fields, and the receiving structures at the two different frequencies produces a beat frequency radiation which has a much lower frequency than the incident radiation. The beat frequency radiation preferably is at a frequency which is sufficiently low that it may be relatively easily converted to useable electrical energy. In contrast, the incident zero point radiation has its desirable high energy densities at frequencies which are so high that conventional systems for converting the radiation to electrical energy either cannot effectively or efficiently so convert the radiation energy or simply cannot be used to convert the radiation energy for other reasons.

The system of the present invention also includes an antenna which receives the beat frequency radiation. The antenna may be a conventional metallic antenna such as a loop or dipole type of antenna or a rf cavity structure which partially encloses the receiving structures. The antenna feeds the radiation energy to an electrical conductor (in the case of a conventional dipole or comparable type of antenna) or to a waveguide (in the case of a rf cavity structure). The conductor or waveguide feeds the electrical current (in the case of the electrical conductor) or the electromagnetic radiation (in the case of the wave guide) to a converter which converts the received energy to useful electrical energy. The converter preferably includes a tuning circuit or comparable device so that it can effectively receive the beat frequency radiation. The converter may include a transformer to convert the energy to electrical current having a desired voltage. In addition, the converter may also include a rectifier to convert the energy to electrical current having a desired waveform.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the receiving structures and antenna of a first embodiment of the system of the present invention with a schematic view of the conductor and converter thereof and also showing the incident primary and emitted secondary electromagnetic radiation.

FIG. 2 is a front view of the receiving structures, antenna and waveguide of a second embodiment of the system of the present invention with a schematic view of the converter thereof and also showing the

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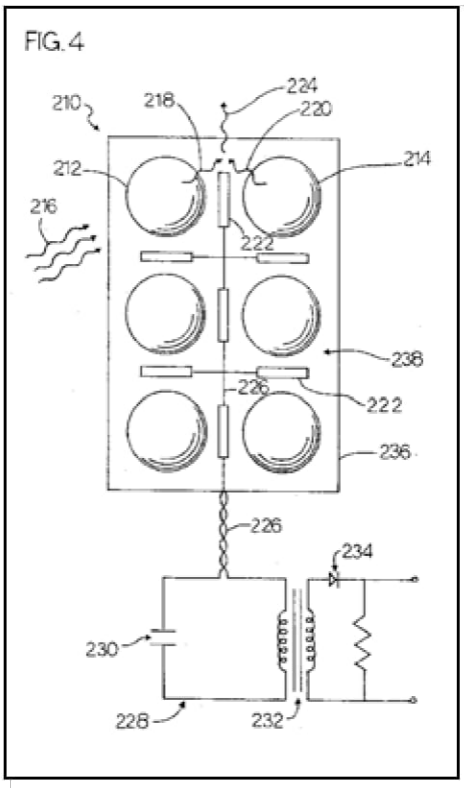


incident primary and emitted secondary electromagnetic radiation.

FIG. 3 is a perspective view of the receiving structures, antenna and waveguide of the second embodiment shown in FIG 2 with a schematic view of the converter thereof and also showing the incident primary and emitted secondary electromagnetic radiation.

FIG. 4 is a front view of the substrate and a plurality of pairs of the receiving structures and a plurality of antennas of a third embodiment of the system of the present invention with a schematic view of the conductor and converter thereof and also showing the incident primary and emitted secondary electromagnetic radiation.

FIG. 5 is a top view of some of the components of the third embodiment of the system of the present invention showing two of the plurality of pairs of receiving structures and two of the plurality of antennas mounted on the substrate.

FIG. 6 is a diagram of a receiving structure of the system of the present invention showing an incident electromagnetic plane wave impinging on the receiving structure and illustrating the directions of the electric and magnetic field vectors thereof.

FIG. 7 is a diagram of a spherical coordinate system as used in the formulas utilized in the system of the present invention.

FIG. 8 is a graph showing an imaginary parameter plotted against a real ρ parameter illustrating the values thereof at resonance as well as values thereof at other than resonance.

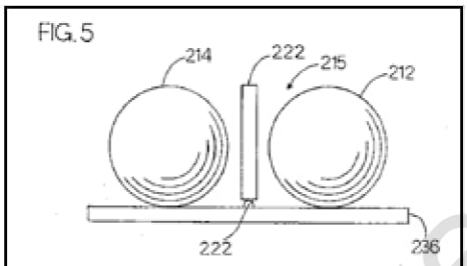
FIG. 9 is a graph showing a portion of the graphical representation shown in FIG. 8 illustrating the real and imaginary ρ values at or near a single resonance.

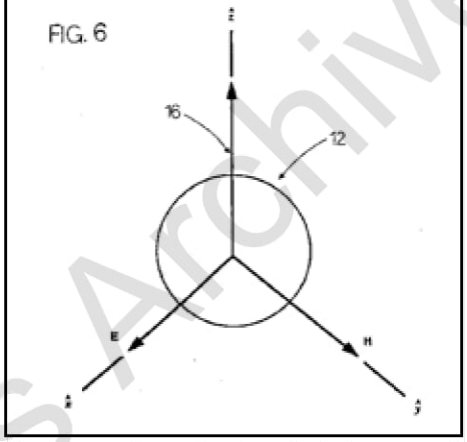
DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, a first embodiment of the present invention is generally designated by the numeral 10. The system 10 includes a first and second means for receiving 12 and 14 incident electromagnetic radiation 16. The means for receiving 12 and 14 are preferably a pair of spherical structures 12 and 14 which are preferably composed of a dielectric material. Alternatively, the spheres 12 and 14 may be cubical structures or any other suitable shape. The spheres 12 and 14 may be mounted on a suitable foundation by any suitable mounting means (not shown), or spheres 12 and 14 may be suspended from a suitable foundation by any suitable suspension means (not shown). The spheres 12 and 14 are preferably composed of a dielectric material. The dielectric spheres 12 and 14 scatter and concentrate electromagnetic waves. At very sharply defined frequencies, the spheres 12 and 14 will have resonances wherein the internal energy densities can be five orders of magnitude larger than the energy density of the incident electromagnetic field driving the spheres 12 and 14. At resonance, the electromagnetic stresses, equivalent to pressures proportional to the energy density, can cause material deformation of the spheres 12 and 14 which produce a secondary electromagnetic field. The spheres 12 and 14 are preferably positioned proximal to each other, as shown in FIG. 1. Although the proximity of the spheres to each other will adversely affect the resonances, the very high "Q's" of the isolated-sphere resonances results in such adverse affect being relatively small. However, the proximity of the spheres 12 and 14 allows the spheres to interact electromechanically which increases the magnitude of the secondary radiation emitted therefrom.

The electromagnetic radiation incident upon the spheres 12 and 14 which drives the spheres to resonance is preferably zero point radiation 16. However, other types of electromagnetic radiation may also be used to drive the spheres 12 and 14, if desired.

The effect of a dielectric sphere such as 12 or 14 on an incident electromagnetic radiation such as a plane wave thereof is shown in FIG.6. The plane wave propagates in the z-axis direction and is diffracted by the sphere 12 resulting in scattering thereof. This scattering is commonly





known as Mie scattering. The incident radiation wave has an electric vector component which is linearly polarized in the x axis direction and a magnetic vector component which is linearly polarized in the y axis direction.

An electromagnetic wave incident upon a structure produces a forced oscillation of free and bound charges in synch with the primary electromagnetic field of the incident electromagnetic wave. The movements of the charges produce a secondary electromagnetic field both inside and outside the structure. The secondary electromagnetic radiation comprising this secondary electromagnetic field is shown in FIG. 1 and designated by the numerals 18 and 20. An antenna which is shown simply as a loop antenna but may also be a dipole or any other suitable type of antenna is also shown in FIG. 1 and designated by the numeral 22. The nonlinear mutual interactions of the spheres produces inter-

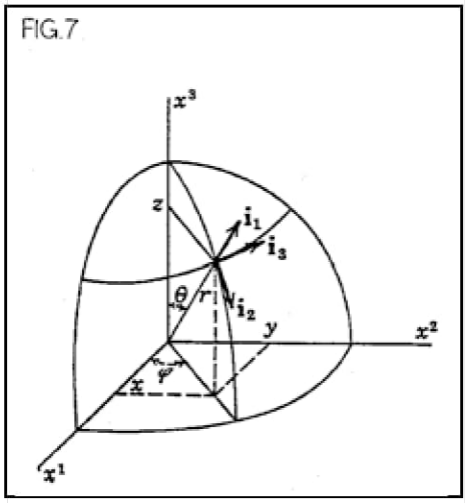


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FIG. 8

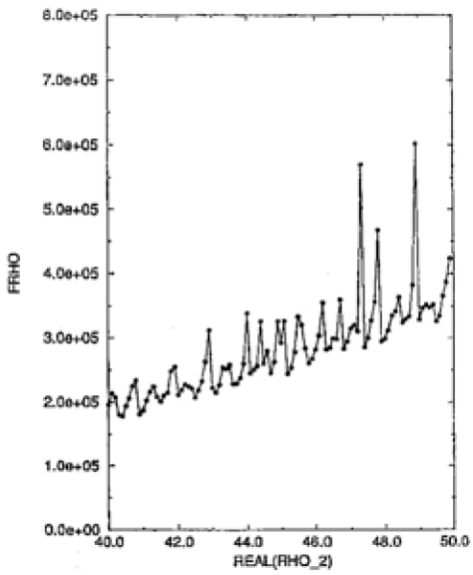
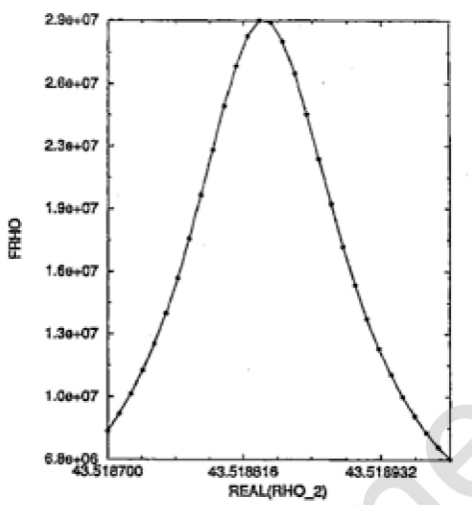


FIG. 9



ference between the secondary electromagnetic radiation 18 and 20 produces a beat frequency radiation 24 which is preferably at a much lower frequency than the primary radiation 16. It is this beat frequency radiation 24 which is desired for conversion into electrical energy because it preferably is within the frequency range of rf radiation which may be converted into electrical energy by generally conventional systems. Thus, the radiation 24 received by the antenna 22 is fed via an electrical conductor 26 to a means for converting the beat frequency radiation 24 to electrical energy. This means for converting is designated by the numeral 28 and preferably includes a tuning capacitor 30 and a transformer 32 and a rectifier (preferably a diode) 34. Instead of including the capacitor 30, transformer 32 and rectifier 34, the converter 28 may alternatively include an rf receiver of any suitable type.

The resultant field at any point is the vector sum of the primary and secondary fields. For the equations that follow, the structure receiving the incident plane wave is a sphere of radius a having a propagation constant k_1 positioned in an infinite, homogeneous medium having a propagation constant k_2. The incident plane wave propagates in the z axis direction and is as shown in FIG. 6. The spherical coordinate system used for the vector spherical wavefunctions is shown in FIG. 7. Expansion of the incident field provides:

$$E_i = E_0 e^{-i\omega t} \sum_{n=1}^{\infty} i^n \frac{2n+1}{n(n+1)} \left(m_{01n}^{(1)} - i n_{e1n}^{(1)}\right)$$

$$H_i = -\frac{k_2}{\omega\mu_2} E_0 e^{-i\omega t} \sum_{n=1}^{\infty} i^n \frac{2n+1}{n(n+1)} \left(m_{e1n}^{(1)} + i n_{01n}^{(1)}\right)$$

where E is the electric field and H is the magnetic field; and

$$m_{\substack{01n\\e1n}}^{(1)} = \pm \frac{1}{\sin\theta} j_n(k_2R) P_n^1(\cos\theta) \begin{matrix}\cos\\ \sin\end{matrix} \phi i_2 - j_n(k_2R) \frac{\partial P_n^1}{\partial\theta} \begin{matrix}\sin\\ \cos\end{matrix} \phi i_3$$

$$n_{\substack{01n\\e1n}}^{(1)} = \frac{n(n+1)}{k_2R} j_n(k_2R) P_n^1(\cos\theta) \begin{matrix}\sin\\ \cos\end{matrix} \phi i_1 + \frac{1}{k_2R} [k_2Rj_n(k_2R)]' \times \frac{\partial P_n^1}{\partial\theta} \begin{matrix}\sin\\ \cos\end{matrix} \phi i_2 \pm \frac{1}{k_2R\sin\theta} [k_2Rj_n(k_2R)]' P_n^1(\cos\theta) \begin{matrix}\cos\\ \sin\end{matrix} \phi i_3.$$

The electric and magnetic fields of the incident wave transmitted into the sphere i.e., R<a, can be similarly expanded:

$$E_t = E_0 e^{-i\omega t} \sum_{n=1}^{\infty} i^n \frac{2n+1}{n(n+1)} \left(a_n^t \, {}_{01n}^{(1)} - i b_n^t \, {}_{e1n}^{(1)}\right)$$

$$H_t = \frac{k_2}{\phi\mu_1} E_0 e^{-i\omega t} \sum_{n=1}^{\infty} i^n \frac{2n+1}{n(n+1)} \left(b_n^t \, {}_{e1n}^{(1)} - i a_n^t \, {}_{01n}^{(1)}\right)$$

If $j_n(k_2R)$ is replaced by $h_n^{(1)}(k_2R)$ in the previous equations, the functions $m^{(1)}$ and $n^{(1)}$ become $m^{(3)}$ and $n^{(3)}$. The outgoing fields ie., R>a, are represented by:

$$E_R = E_0 e^{-i\omega t} \sum_{n=1}^{\infty} i^n \frac{2n+1}{n(n+1)} \left(a_n^r \, {}_{01n}^{(3)} - i b_n^r \, {}_{e1n}^{(3)}\right)$$

$$H_r = \frac{k_2}{\phi\mu_1} E_0 e^{-i\omega t} \sum_{n=1}^{\infty} i^n \frac{2n+1}{n(n+1)} \left(b_n^r \, {}_{e1n}^{(3)} - i a_n^r \, {}_{01n}^{(3)}\right)$$

where H_r represents the resultant wave in the medium surrounding the sphere. At resonance, the values of ρ at resonance require that the an' and bat coefficients be infinite. in order to determine these values of a_n^t and b_n^t, the boundary conditions at the sphere radius are needed. Since there must be continuity of the E and H values at the surface, the following equations are used:

$$i_1 \times (E_i + E_r) = i_1 \times E_t \text{ and}$$

$$i_1 \times (H_i + H_r) = i_1 \times H_t$$

which lead to two pairs of inhomogeneous equations:

$$a_n^t j_n(N\rho) - a_n^r h_n^{(1)}(\rho) = j_n(\rho)$$

$$\mu_2 a_n^r [N\rho j_n(N\rho)]' - \mu_1 a_n^r [\rho h_n^{(1)}(\rho)]' = \mu_1 [\rho j_n(\rho)]' \text{ and}$$

$$\mu_2 N b_n^t j_n(N\rho) - \mu_1 b_n^r h_n^{(1)}(\rho) = \mu_1 j_n(\rho)$$

$$b_n^t [N\rho j_n(N\rho)]' - N b_n^r [\rho h_n^{(1)}(\rho)]' = N[\rho j_n(\rho)]'$$

where $k_1 = Nk_2$, $\rho = k_2 a$, $k_1 a = N\rho$. Spherical Bessel functions of the first kind are denoted by j_n while those of the third kind are denoted by $h_n^{(1)}$. The resulting equations are:

$$a_n^t = \frac{\mu_1 j_n(\rho)[\rho h_n^{(1)}(\rho)]' - \mu_1 h_n^{(1)}\rho)[\rho j_n(\rho)]'}{\mu_1 j_n(N\rho)[\rho h_n^{(1)}(\rho)]' - \mu_2 h_n^{(1)}(\rho)[N\rho j_n(N\rho)]'}$$

$$b_n^t = \frac{\mu_1 N j_n(\rho)[\rho h_n^{(1)}(\rho)]' - \mu_1 N h_n^{(1)}\rho)[\rho j_n(\rho)]'}{\mu_2 N^2 j_n(N\rho)[\rho h_n^{(1)}(\rho)]' - \mu_1 h_n^{(1)}(\rho)[N\rho j_n(N\rho)]'}$$

At a resonance, the denominator of either a_n^t or b_n^t will be zero. Thus, ρ values are found using the above equations that correspond to a resonant combination of angular frequency (ω) and radius (a) for a given sphere material and given surrounding medium. In determining such values of ρ, the following equations are also specifically used:

$$\rho = ak_2 = a\omega\sqrt{\epsilon_2\mu_1} \text{ and}$$

$$\rho_1 = (k_1/k_2)\rho$$

where ρ_1, corresponds to the sphere material. An iterative method is preferably used to find the desired value of ρ at resonance. In calculating ρ utilizing the above equations for purposes of example, it was assumed that $\mu_1 = \mu_2 = \mu_0 = 4\pi \times 10^{-7}$ and $\varepsilon_2 = \varepsilon_0 = 8.85419 \times 10^{-12}$.

One major root of ρ which was found has a value of:

Real (ρ) =+66.39752607619131
Imaginary (ρ)=-0.6347867071968998

These particular values are not shown in FIG. 8. However other values of ρ found using the equations set forth herein are shown in FIG. 8. The peaks in FIG. 8 are the resonances. One of these resonances shown in FIG. 8 is shown in detail in FIG.

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9. These resonance values are shown for purposes of example. Other resonances also exist which have not been determined; thus, not all possible resonance values are shown in FIGS. 8 and 9.

Calculation of these values also allows the determination of a possible am combination which would have these root values. For ρ, ε(epsilon)=ε_0 and μ=μ_0 and

$$\rho = a\omega\sqrt{\varepsilon_0\mu_0} = a\omega/c.$$

Expressed in SI units, the speed of light c= 2.99792458x10^{11} m/s. If an a value of $l0^{-6}$ m is assumed for the examples shown herein, then:

$$\omega=\rho c/a\approx 1.9919\times10^{16}-i1.9044\times10^{14} \text{ radians/s}$$

This is an example of the angular frequency required within the impingent EM radiation in order to create a resonant situation. Examples of other resonances were indicated, and these are shown in FIG. 8. No complex frequency plane waves exist. Therefore, the calculations were made by considering only the real portion of the above root and setting the imaginary portion equal to zero. However, upon doing this, the iterative calculation procedure becomes insensitive to any root in the vicinity of the root's real portion. In the iterative calculation procedure, initially a range of ρ values is input into the equations. These ρ values are in the neighborhood of the prospective root. A range of ρ values is subsequently studied to find any imaginary ρ i.e., $f\rho$ (a function of ρ), peaks in that range. Next, once a peak has been chosen, the function order n giving the dominant $f\rho$ is determined. This also gives a clue as to whether the peak is due to a magnetic resonance (b_n approaches infinity) or an electrical resonance (b_n approaches infinity). A large number of Newton-Raphson iterations is preferably performed in order to converge upon a root ρ value.

FIGS. 2 and 3 show a second embodiment of the present invention generally designated by the numeral 110. Embodiment 110 is essentially the same as embodiment 10 except that the antenna is a rf cavity structure 122 which feeds the received beat frequency radiation 124 to a waveguide 126. Embodiment 110 also preferably includes two spheres 112 and 114 which receive the primary incident electromagnetic radiation 116 and emit the secondary electromagnetic radiation 118 and 120. As with the spheres 18 and 20 of embodiment 10, spheres 118 and 120 are preferably composed of a dielectric material. Embodiment 110 also includes converter 128, capacitor 130, transformer 132 and rectifier 134 which are essentially identical to the correspondingly numbered elements of embodiment 10. Therefore, a description of these components of embodiment 110 will not be repeated in order to promote brevity. In addition, the same equations and method of calculation set forth above with regard to embodiment 10 also apply to embodiment. Therefore, their description will not be repeated in order to promote brevity.

FIGS. 4 and 5 show a third embodiment of the present invention generally designated by numeral 210. Embodiment 210 is essentially identical to the first embodiment 10 except that the embodiment 210 includes a plurality of pairs 215 of receiving means (spheres) 212 and 214 mounted on a substrate 236. The spheres 212 and 214 are thus in the form of an array 238. The pairs 215 of the array 238 are preferably positioned proximal to each other in order to maximize the amount of energy extracted from a particular area or space of a given size. Since, as set forth hereinabove, the energy density of the zero point radiation increases as the frequency of the radiation increases, it is desirable that the spheres resonate at as high a bandwidth of frequencies as possible. Because the spheres 212 and 214 must be small in direct proportion to the wavelength of the high frequencies of the incident electromagnetic radiation 216 at which resonance is desirably obtained, the spheres 212 and 214 are preferably microscopic in size. Current lithographic techniques are capable of manufacturing such microscopically small spheres mounted on a suitable substrate thereby providing a suitably miniaturized system 210. A miniaturized system enhances the energy output capability of the system by enabling it to resonate at higher frequencies at which there are correspondingly higher energy densities. Consequently, utilization of array 238 in the system 210 enhances the maximum amount of electrical energy provided by the system 210.

Lithographic techniques may be more amenable to manufacturing microscopically small receiving structures 212 and 214 which may be disc shaped, semispherical or have another shape other than as shown in FIGS. 4 and 5. Consequently, the receiving means 212 and 214 may accordingly have such alternative shapes rather than the spherical shape shown in FIGS. 4 and 5. In addition, a large number of small spheres may be manufactured by bulk chemical reactions. Packing a volume with such spheres in close proximity could enhance the output of energy.

Embodiment 210 also Includes a plurality of antennas 222 positioned preferably between the spheres 212 and 214 which receive the beat frequency radiation 224 produced by the interference between the secondary radiation 218 and 220. The antennas 222 are shown as loop antennas 222 but may be any other suitable type of antennas as well.

Embodiment 210 has a plurality of electrical conductors 226 which preferably include traces mounted on the substrate 236 which occupies a finite volume. The electrical conductors 226 feed the electrical output from the antennas 222 to a suitable converter 228 which preferably includes tuning capacitor 230, transformer 232 and rectifier 234, as with embodiments 10 and 110. Except as set forth above, the components of embodiment 210 are identical to embodiment 10 so the detailed description of these components will not be repeated in order to promote brevity. In addition, the same equations and method of calculation set forth above for embodiment 10 also apply to embodiment 210. Therefore, the description of these equations and method of calculation will not be repeated in order to promote brevity.

Accordingly, there has been provided, in accordance with the invention, a system which converts high frequency zero point electromagnetic radiation into electrical energy effectively and efficiently and thus fully satisfies the objectives set forth above. It is to be understood that all terms used herein are descriptive rather than limiting. Although the invention has been specifically described with regard to the specific embodiments set forth herein, many alternative embodiments, modifications and variations will be apparent to those skilled in the art in light of the disclosure set forth herein. Accordingly, it is intended to include all such alternatives, embodiments, modifications, and variations that fall within the spirit and scope of the invention as set forth in the claims hereinbelow.

What is claimed is:

1. A system for converting incident electromagnetic radiation energy to electrical energy, comprising

a first means for receiving incident primary electromagnetic radiation, said means for receiving producing emitted secondary electromagnetic radiation at a first frequency, said first means for receiving having a first volumetric size selected to resonate at a frequency within the frequency spectrum of the incident primary electromagnetic radiation in order to produce the secondary electromagnetic radiation at the first frequency at an enhanced energy density;

a second means for receiving the incident primary electromagnetic radiation, said means for receiving producing emitted secondary electromagnetic radiation at a second frequency, the secondary radiation at the first frequency and the secondary radiation at the second frequency interfering to produce secondary radiation at a lower frequency than that of the incident primary radiation, said second means for receiving having a second volumetric size selected to resonate at a frequency within the frequency spectrum of the incident primary electromagnetic radiation in order to produce the emitted sec-

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ondary electromagnetic radiation at the second frequency at an enhanced energy density;

an antenna for receiving the emitted secondary electromagnetic radiation at the lower frequency, said antenna providing an electrical output responsive to the secondary electromagnetic radiation received;

a converter electrically connected to said antenna for receiving electrical currant output from said antenna and converting the electrical current output to electrical current having a desired voltage and waveform

2. The system of claim 1 wherein

said first means for receiving is composed of a dielectric material; and

said second means for receiving is comprised of a dielectric material.

3. The system of claim 1 wherein:

said first means for receiving is spherical; and

said second means for receiving is spherical

4. A system for for converting incident zero point electromagnetic radiation energy to electrical energy, comprising:

a first means for receiving incident primary zero point electromagnetic radiation said means for receiving producing emitted secondary electromagnetic radiation at a first frequency;

a second means for receiving the incident primary zero point electromagnetic radiation said means for receiving producing emitted secondary electromagnetic j radiation at a second frequency, the secondary radiation at the first frequency and the secondary radiation at the second frequency interfering to produce seminary radiation at absatfrequency which is lower than that of the incident primary radiation;

an antenna for receiving the emitted secondary electromagnetic radiation at the lower frequency, said antenna providing an electrical output responsive to the secondary electromagnetic radiation received;

means for transmitting the emitted secondary electromagnetic radiation at the beat frequency from said antenna, said means for transmitting connected to said antenna;

a converter connected to said means for transmitting for receiving the emitted secondary electromagnetic radiation at the beat frequency from said antenna and converting the same to electrical current having a desired voltage and waveform.

5. The system of claim 4 wherein:

said first means for receiving has a first volumetric spherical size selected to resonate in response to the incident primary electromagnetic radiation in order to produce the secondary electromagnetic radiation at the first frequency at an enhanced energy density; and

said second means for receiving has a second volumetric spherical size elected to resonate in response to the incident primary electromagnetic radiation in order to produce the emitted secondary electromagnetic radiation at the second frequency at an enhanced energy density, said first and second volumetric sizes selected based on parameters of propagation constant of said first and second means for receiving, propagation constant of medium in which said first and second means for receiving are located and frequency of the incident primary electromagnetic radiation.

6. The system of claim 5 wherein the first and second volumetric sizes are selected by utilizing the formulas:

$$a_n^t = \frac{\mu_1 j_n(\rho)[\rho h_n^{(1)}(\rho)]' - \mu_1 h_n^{(1)}\rho)[\rho j_n(\rho)]'}{\mu_1 j_n(N\rho)[\rho h_n^{(1)}(\rho)]' - \mu_2 h_n^{(1)}(\rho)[N\rho j_n(N\rho)]'}$$

$$b_n^t = \frac{\mu_1 N j_n(\rho)[\rho h_n^{(1)}(\rho)]' - \mu_1 N h_n^{(1)}\rho)[\rho j_n(\rho)]'}{\mu_2 N^2 j_n(N\rho)[\rho h_n^{(1)}(\rho)]' - \mu_1 h_n^{(1)}(\rho)[N\rho j_n(N\rho)]'}$$

$$\rho = a\omega\sqrt{\epsilon_2\mu_2}$$

wherein at a resonance, the denominator of either equation for a_n^t or b_n^t will be approximately zero and wherein k_1=propagation constant of the means for receiving, k_2=propagation constant of medium through which the incident electromagnetic radiation propagates, a is the radius of either means for receiving, $N=k_1/k_2$, $\rho=K_2a$, $k_1a=N\rho$, a_n^t=magnitude of oscillations of the electric field of the nth order, b_n^t=magnitude of oscillations of the magnetic field of the nth order, angular frequency of the incident electromagnetic radiation, ε is the permittivity of the material or medium and ρ is the permeability of the material or medium.

7. The system of claim 6 wherein the radius of the first means for receiving is different from the radius of the second means for receiving, difference between the radius of said first means for receiving and the radius of said second means for receiving selected so that the beat frequency resulting from the difference is a frequency which facilitates conversion of the beat frequency electromagnetic radiation to electrical energy.

8. The system of claim 4 wherein said first means for receiving is composed of a dielectric material; and said second means for receiving is composed of a dielectric material.

9. The system of claim 4 wherein said first means for Motiving is spherical; and

said second means for receiving is spherical.

10. The system of claim 4 wherein said antenna is positioned generally between said first and second means for receiving.

11. The system of claim 4 wherein said antenna is a loop antenna.

12. The system of claim 4 wherein said antenna is a generally concave shell partially enclosing said first and second means for receiving.

13. The system of claim 4 wherein said means for transmitting is a waveguide.

14. A system for converting incident zero point electromagnetic radiation energy to electrical energy, comprising:

a substrate;

a plurality of pairs of first means for receiving incident primary zero point electromagnetic radiation and second means for receiving incident primary zero point electromagnetic radiation, said plurality of pairs of means for receiving mounted on said substrate, said first means for receiving producing emitted secondary electromagnetic radiation at a first frequency, said second means for receiving the incident primary zero point electromagnetic radiation producing emitted secondary electromagnetic radiation at a second frequency, the secondary radiation at the first frequency and the secondary radiation at the second frequency interfering to produce secondary radiation at a beat frequency which is lower than that of the incident primary radiation, said first means for receiving having a first volumetric size selected to resonate in response to the incident primary electromagnetic radiation in order to produce the secondary electromagnetic radiation at the first frequency at an enhanced energy density, and said second means for receiving having a second volumetric size selected to resonate in response to the incident primary electromagnetic radiation in order to produce the emitted secondary electromagnetic radiation at the second frequency at an enhanced energy density, said first and second volumetric sizes selected based on parameters of propagation constant: of said first and second means for receiving, propagation constant of medium in which said first and second means for receiving are located and frequency of the incident primary electromagnetic radiation, said first and second volumetric sizes being different from each other:

a plurality of antennas for receiving the emitted secondary electromagnetic radiation at the lower frequency, said antenna providing an output responsive to the secondary electromagnetic radiation received, said plurality of antennas mounted on said substrate, each of said plurality of antennas receiving the emitted secondary electromagnetic radiation of one of said pairs of first and second means for receiving;

means for transmitting the emitted secondary electromagnetic radiation at the beat frequency from said antenna, said means for transmitting connected to said plurality of antennas;

a converter connected to said means for transmitting for receiving the emitted secondary electromagnetic radiation at the beat frequency from said antenna and converting the same to electrical current having a desired voltage and waveform.

Continued from page 28

interfere with each other producing a beat frequency radiation which is at a much lower frequency than that of the incident radiation and which is amenable to conversion to electrical energy."

Note well the comment in the patent: "The size of the structures are preferably miniaturized in order to produce greater amounts of energy from a system located within a space or area of a given size. In this regard, the smaller the size of the receiving structures, the greater the amount of energy that can be produced by the system of the present invention."

Questions immediately arise. Could this be pointing the way to the use of nanostructures to extract ZPE? Is it possible that if this patent is sound, it points toward an explanation for the cause of cold fusion excess energy and a method for facilitating nuclear reactions? There are many things to ponder!

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COH_2 and AquaFuel™ Update

A Letter from DW Research

Dear Dr. Mallove:

My colleague, Wilbur Dammann, and I appreciate the interest that you and *Infinite Energy* magazine have taken in the Biomass Gasification Process. It is indeed an interesting process.

Our development has been concentrated on the energy conversion aspects of this gasification process, because of its significance to renewable energy from biomass.

We were quite surprised at the calorimetric testing that you encouraged us to do on the gas. We have been very conservative in our approach to the entire development of this process and had assumed the BTU content of our COH_2 synthesis gas was similar to water gas (310 BTU/^{3}). We did suspect that there was an over-unity issue with respect to the electrical input because of results others have obtained with methanol reformation; but at most, we thought it would be a maximum of 22%.

We are in the process of developing a more sophisticated calorimeter (with your input) that should verify original test results (*IE* #10, pg 34-35). I do expect the original tests favored the COH_2 gas because of some heat loss when heating the water with propane (Test D). However, I do think the new results will be fairly close to what we found originally (510 - 550 BTU/ft^3). We hope to have a report ready for *IE* #11.

In addition, we are developing basic laboratory prototypes intended for experimentation and testing. We hope to offer these for sale in the next couple months. They will be available through our company, DW Energy Research, LLC (limited liability company).

By the way, we have decided to name the gas, based on your suggestion. The gas will be called **Carbo-hydrogen™** gas or CH gas™ as a short form. As you mentioned, "Carbo" indicates carbon and oxygen, and can imply carbohydrates (one form of biomass solutions). In addition, carbo-hydrogen is an inversion of hydrocarbon, which seems fitting considering that COH_2 is such a clean burning gas. Carbo-hydrogen™ gas is also descriptive of the gas formed from both types of input solutions: water or biomass. Thank you for such a clever name!

BACKGROUND of the PROCESS

You and your readers may be interested in a little background on how the Biomass Gasification Process was developed. As a teenager, in a rural community, Wilbur Dammann had an increasing interest in science and technology. I mention "rural community" because it is characteristic for people in rural and agricultural communities to build things and invent things as a matter-of-fact, in daily life. Wilbur started taking an interest in cars as most young men do. He began to wonder about how great it would be if cars could run on water instead of gasoline. This prompted years of experimentation with electrolysis and hydrogen production.

As an electrical engineer for the U.S. Air Force at Offutt Air Force Base (Nebr.),Wilbur developed, implemented, and administered a testing laboratory dealing with electronic countermeasures and electronic warfare; it was a good discipline for hydrogen experimentation. He continued to work with electrolysis, as a hobby, throughout his career. One day while experimenting, an accident occurred which caused an electric arc between the electrodes in his electrolysis unit. An electrolytic capacitor in the supply discharged suddenly when the electrodes touched, thus causing a sudden arc. Wilbur essentially produced, what has been referred to as, "a water arc explosion." As you might guess, it was a heart-pounding experience!

This accident caused Wilbur to shift his focus from electrolysis to experimenting with an electric arc in water and led to his discovery of electric-arc gas generation. (Little did he know that the basic process had been discovered in the late 1800's.)

Wilbur made some interesting discoveries in his early experimentation with electric arcs. The first problem was finding the proper material for the electrodes. Different forms of hydrogen-based gas can be generated relative to the type of electrode used in the arc. Wilbur tried aluminum, which produced aluminum oxide precipitate in the water. As the electrodes grew hotter, the tips of the electrodes melted before complete oxidation and pooled in the water.

It was about this time that he realized he had discovered a rapid oxidation process. The electric arc was forcing oxidation of the electrodes. He learned that any conductive substance (as an electrode) would work in this process. Tungsten was tried next, but Wilbur started to speculate about oxides and realized that oxides of carbon are gaseous. Therefore, carbon electrodes were chosen for use in this rapid oxidation process!

The essence of the rapid oxidation process is: **the electric arc forces oxidation (burning) of electrodes in water** [exothermic reaction]. **As hydrogen is released from the water, the oxygen (from water) forms an oxide of the substance from the electrode** [endothermic reaction]. This will work with any conductive substance used for the electrode.

If you put this explanation into perspective with the "water arc explosion" phenomenon, there is a plausible explanation for that phenomenon. The electric arc causes almost instantaneous generation of gas through rapid oxidation of the electrode(s) (DC or AC). The gas produced has a dramatic expansion if not contained. Essentially no heating of the water or solution occurs when there is a short duration arc discharge, because the oxidation of the electrode(s) is an endothermic reaction. Heat is absorbed by the gas product of the reaction.

Instantaneous gas generation in a small cavity or container will produce spectacular results, especially when you consider that water is incompressible! (illustrated in Figure 1, pg. 60 of Dr. Peter Graneau's paper "Gaining Solar Energy from Ordinary Water," *IE*#10). Maybe Wilbur should have gone public with his discoveries 25 years ago. Our Biomass Gasification reactor deals with this phenomenon through the design we have incorporated.

Back to the history of our process... Once carbon electrodes were used in Wilbur's early experiments, any precipitate was eliminated; a carbon-hydrogen gas was produced. Gas chromatography confirmed the gas produced is COH_2 which is similar to water gas.

This gasification process was covered by U.S. patent 5,159,900 issued Nov. 3, 1992. However, a difficulty existed in the process; How can the carbon electrodes be replenished during operation?

I started working with Wilbur several years ago. I am also an electrical engineer and most recently was employed by Hewlett-Packard Co. for 16 years. Together, Wilbur and I tried several iterations of the gasification process; we eventually developed the Biomass Gasification Process. We discovered this process through the use of carbohydrate and water solutions (sugar water). The beauty of the process is that the carbon electrodes can be replenished through a carbon plating process (deposition). Using DC current,

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the anode would be oxidized and shortened, while the cathode would be plated with carbon from the solution. In order to maintain the electrodes, the polarity is reversed when the anode becomes too short, and the plating process is reversed.

NOTE: *Carbon plating and reversing polarity are a couple of the important issues that are covered by U. S. Patent No. 5,417,817 and various foreign patents.*

Not only did we solve the carbon replenishment problem but we discovered a new source of fuel: biomass feedstock solutions. The solution can be carbohydrates (sugars and starches), cellulosic solutions, alcohols, or any organic based solution. Thus we have a renewable energy conversion process!

As I mentioned previously, we have concentrated our efforts on the energy conversion process because of the importance to the energy and biomass industries. We have been conservatively addressing the conversion efficiency. We knew that when compared to electrical input alone, the gasification efficiency is an over-unity situation. However, there are other inputs to the process. Nevertheless, endothermic reactions are interesting animals and can offer some surprises when closely analyzed. Our current system runs a 7500° F carbon arc one inch from a Plexiglas reactor wall; the Plexiglas does not even soften! We discovered this after building a hefty prototype which incorporated large heat sinks around the reaction chamber; they were not needed.

APPLICATIONS

We have been getting many inquiries about the application of the Biomass Gasification process and system. I think the immediate response, when one learns about the process, is a transportation fuel. I believe this is a great application, however, this will probably have to be addressed on an OEM basis rather than by pushing it into the automotive industry.

I think the more immediate market will be using Carbo-hydrogen™ gas as a chemical raw material and as an industrial fuel. A prominent market is the production of commercial hydrogen (mainly produced from methane today). Also, commercial carbon dioxide can be produced at the same time through a process known as the Bosch process. Fuel cells, biodegradable plastics, pharmaceutical production, and other chemical processes use COH_2 gas or its by-products (eg. hydrogen & CO_2).

Undoubtedly, Carbo-hydrogen™ gas also has the ability to impact all aspects of the transportation industry, including fossil fuels. However, development in those applications will be required in order to optimize internal combustion engines to a gaseous fuel and also to adapt the fuel infrastructure to biomass supply stations. It is interesting that a form of this gas was used for transportation in Western Europe during WWII. Due to gasoline shortages, many automobiles were retrofitted with pyrolysis units that burned wood and charcoal to produce COH_2 synthesis gas. A book by Lincoln Ware, *Driving Without Gas*, contains an interesting account along with photographs.

Not having to breath hydrocarbons, carbon monoxide, aldehydes, and other gasoline and diesel combustion products, in traffic, does sound appealing. The fact that carbohydrogen™ gas can be generated on-demand in a vehicle certainly has safety implications also.

Currently, we are concentrating on technical development and are not selecting any one application. First, because there are too many applications to address, and secondly, our expertise is in the technology. Therefore, we see the importance in building laboratory prototypes for others to do experiments. In addition we are willing to make various forms of licensing agreements so others can chose applications for the technology.

PATENT ISSUES

We wish we were a little further along in perfecting our system, but we have spent a lot of resources on protecting our intellectual property through foreign and domestic patents.

As you might guess the U.S. Patent Office first refused to grant Wilbur's 1992 patent because the preliminary examiner thought it might be a perpetual motion scheme. Sounds familiar, doesn't it?

Earlier, I alluded to carbon-arc gasification being discovered in the late 1800's. In fact it was, as the 1898 Eldridge patent (Electrical Retort) shows, which was printed on pg 45-48 of *IE* #10. When Wilbur and I discovered this, we realized the U.S. Patent Office had missed this also. If read closely, it can be seen that the Eldridge patent clearly covers carbon-arc gasification of water, even though it is called electrolysis. During our development, I was in the habit of stating that this basic process should have been discovered 100 years ago; IT WAS! It had just not been developed into a practical process.

Wouldn't it be interesting if some of your Galveston, Texas readers could uncover some of the history behind Eldridge et al?

After discovering the Eldridge patent, we realized that it affected Wilbur's 1992 patent and claims. Federal regulations required that a disclaimer be filed on the 1992 patent because the 1898 patent nullified certain issues. The 1992 patent was printed on pg. 39-41 of *IE* #10, as it had been originally issued by the patent office. But, now it has an official disclaimer attached. The bottom line in all of this is that *carbon-arc gasification of water is in the public domain*. However, our patents (5,159,900 & 5,417,817) cover issues related to the implementation of electrode controls as well as other important issues. (Note that the 1995 patent [pg 42 *IE* #10] cites the Eldridge patent.)

We think we have good patent protection because we patented the technology and processes that make water or biomass gasification practical. We did not patent an application of the gas but the technology itself.

An important issue for you and your readers to know is that we (DW Energy Research) are completely open to licensing and use proposals and would like to encourage you and your readers to experiment with the process. We are easy to get along with, but we will defend our patents.

We plan to have laboratory units available as soon as we can, and we are also willing to license units that others may want to build. This has been, and continues to be, an exciting field for us! We hope you and your readers will join in on the discovery process.

Thank you again for your interest. We are pleased to get the attention of the academic/ scientific world and hope to commercialize the process eventually.

Best regards,

W. David Wallman
Manager

P.S. -

There have been a couple references in recent issues (*IE* #9; IE #10, pg 32) to cutting through steel with an oxy-torch and that the ability to do this, indicates a high BTU content of the heating gas used. One must remember the power of oxidation and the fact that oxygen is at work here and not the heating gas used in the torch.

A recent article in *Scientific American* (Dec. 1996) shows this all too clearly. *Scientific American* announced their "Ignoble Awards" for 1996 in that issue. One went to a group of physics students at Purdue University. The students filled a barbecue with charcoal and poured liquid oxygen onto the charcoal. The charcoal ignited within three seconds after a lighted cigarette was thrown in. Within a short time of ignition, the entire barbecue was essentially vaporized; an outstanding example of RAPID OXIDATION. I understand Dave Barry wrote a recent newspaper column on this incident also.)

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Strange-Particle Catalysis in the Production of COH_2 Gas or Iron.

by Dr. Joseph L. McKibben

Information discussed in issues No. 10 and No.9 of *IE* was quite exciting in that a practical non-polluting fuel was discussed whose production seems to be assisted by the process of cold fusion. Mallove's discussion on page 32 of *IE*#10 suggests a factor that might be as large as 2.6 "more energy out in terms of water heating and gas energy than the combined electrical energy and carbon chemical energy in." Using the concepts discussed below, this factor may be explainable and may be made to be much larger.

Now the author discussed possible catalytic particles in an article printed in *IE*#4 that so far has not been verified by experiment [*Ed. Note: No one has yet attempted the suggested experiment!]*. A particle, which I named subquark and which has the mass of ≈1.15 nucleons, when attached to ^{4}He seemed to me to be a candidate for an ideal catalytic agent. Now the subquarks have considerable color charge—particle theorists designate these colors by red, green, and blue. The force between color charges is very strong; however, it appears to fall off much faster than $1/r^2$. Each of the three subquarks have an electric charge of only +e/6. It appeared from the data analyzed that three ^{4}He nuclei with their attached subquarks could come close to each other and yet not interact—the net electrical charge of the assembly is +e/2. Present also are particles with mass of ≈0.15 nucleons, having electric charge of +e/2 and probably some anticolor charge. The pseudonucleus formed by these six particles has charge +8e so the atom resembles oxygen very well.

The subquark was found attached to various nuclei with a binding energy of ≈15 MeV per nucleon in the nucleus so it is attached to ^{4}He by 60 MeV. On the other hand, evidence was observed that their energy of attachment is radiated very slowly. These properties make the subquarks-^{4}He particle to be an ideal catalytic agent. However, there is a problem with it inasmuch as they are locked up in neutral atoms with properties identical to oxygen atoms. In cold fusion reactors an excited ^{4}He nucleus is formed on the surface of this catalytic particle and they fly apart dividing up the excitation energy between them. This is 23.85 MeV in the case the helium nucleus is formed from two deuterons. In the case of the Patterson cell the helium production seems to be easily produced when it is new; however, the catalytic particle induces reactions in the material on the surface of the beads and so the hot cell soon becomes weak. Miley and Patterson published a paper on the contamination of nickel with Fe, Ag, Cu, Mn, and Mg in *IE*#9.

Now we have patented processes for the production of (a) AquaFuel™ and (b) "COH_2" that are both capable of running an automobile engine without forming polluting combustion products. Both are produced by operating an arc between carbon electrodes in water—they differ only in the source of the carbon. The major components of the gas is hydrogen and carbon monoxide. Now the exciting property is that the energy content of the gas generated is larger than the energy put in. As noted in the first paragraph, the ratio was estimated by Mallove as being between 2.6 and 4.2 That in my opinion is reasonable because the arc would have disassociated He "oxygen" nuclei containing the subquark-^{4}He catalytic components and they seem to have the capability of fusing together carbon and oxygen nuclei.

That this catalytic particle was able to form iron from two carbon nuclei and two oxygen nuclei has been noted and reported in *IE*#10 on page 55. A reaction involving a pair of ^{18}O nuclei was suggested but because of the low abundance of isotope 18 relative to 16, the probability of that reaction has a factor of 250,000 against it.

Now the direct reaction would produce ^{56}Ni which would release 51.09 MeV according to my 1985 "Nuclear Wallet Cards"; however, that isotope decays with a 6.10 day half-life to ^{55}Co which in turn would decay with a 78.76 day half-life to ^{56}Be. Now the iron was seen immediately after the arc was run so the two positrons must have been emitted very quickly while the nucleus was still in the excited state. In doing so ≈55.85 MeV would have been released. The catalytic particle would very quickly fly away from the iron nucleus with quite large kinetic energy. Other atoms were also formed but this one was easy to observe by exposing the residue sample to a bar magnet.

If the gas created by the arc is passed through an electric field, the fractionally charged components should be collected upon the electrodes. They then could be analyzed by a mass spectrograph; however, it needs to have great sensitivity as can be obtained by using an electron-multiplier type detector. The experimentalist needs to measure the particles as both positive and negative ions in order that their identification be unequivocal. Now if fractionally charged particles are actually discovered, a lot of good particle physicists are going to have to eat crow. Cold fusion will then become (for them) a "respectable endeavor."

The observation of the mass and charge of the catalytic particles will not only make plausible the over-unity energy production but suggests that the ratio can be made even greater. This could be done if the catalytic particles are collected and introduced into another sample of water. In doing so, care must be taken so the ratio does not become over unity or one can produce an explosive mixture that has great power—this would be triggered by striking an arc in it. But such fuel should be wonderful for rocket propulsion if catalytic content is only near critical.

Note added by Dr. McKibben:

I realize there is potential for an extremely valuable patent here. However, verification that the catalytic particles do exist and can be removed this way is necessary before it would be considered by any patent office.

I am 84 years old and am now living in a retirement home called Crown Pointe. I personally would not realize much out of the patent unless I sold it. On the other hand, nobody can take the credit away from me from having this idea, so I would like to get on with having my ideas verified. It will then become obvious to many people that the suggested experiment should be carried out. The possibility of spiking the water will then also become obvious.

EDITOR'S NOTE:

Dr. Joseph McKibben received his Ph.D. in physics from the University of Wisconsin and worked on the Manhattan Project. He operated the countdown timer for the first atomic bomb test on July 16, 1945. He retired from Los Alamos National Laboratory in 1980.

Readers are urged to review his basic proposals for fractionally charged ions acting as catalysts in cold fusion. See *IE* Issue #4, pp.14-23.

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Test report of BTU content of Carbo-hydrogen™ (COH_2) gas generated from biomass as compared with propane and acetylene.

D_W Energy Research, LLC, 1350 Northface Ct., Colorado Springs, CO 80919, Ph: 719-598-1426

Introduction:

Previous testing to determine BTU content of COH_2 gas (see *IE*, Issue #10), because of the unusual, apparently over-unity results, certainly necessitates confirmation by other means.

Prior tests used small amounts of water heated in an open container with a measured amount of propane burned in air and compared to the same volume of COH_2 also burned in air, resulting in a delta temperature ratio of 4.78: 1. Reference book values of 2,440 to 2,652 BTU/ft^3 for propane were used. Applying this ratio to BTU calculations provided a rating for COH_2 of 510.5 to 554.8 BTU. It was desirable to validate these values by using a larger quantity of water and a method that would more fully capture the heat from the reaction. The actual reference gas BTU rating was obtained from the vendor for the propane used (Liquefied Petroleum UN 1075). Acetylene was used as an additional reference.

Method of test:

A heat exchanger was constructed, using a 20 ft. length of 3/8-inch copper tube, coiled to fit inside of a Styrofoam container, to transfer heat from the burning gas to a measured amount of water in the container. The inlet end of the tube was split and flared to provide a wide opening for entry of the flame. The outlet of the tube was connected to a source of suction to draw the flame into the tube. Four pounds of water were used to completely cover the coiled tube. The temperature of the water was monitored using thermistor probe thermometers. The minimum (at start) and maximum temperatures were recorded for each test run.

The amount of gas used for each test was measured and pressure-regulated using a two chamber container. The container is comprised of two chambers, which are sealed from each other except for a passage at the bottom. The right side chamber was used for gas volume measurement. It was calibrated in 0.05 liter marks. At start, water filled the right side and approximately 0.25 liter on the left side. An air compressor was connected to the left chamber through a valve on top. The air regulator was adjusted to 5 psig. This method kept the gas at a fairly constant pressure as it was being filled or burned off.

The right (gas) chamber was marked with two marks, the volume between the two marks being 1 liter. Gas filled the chamber to below the lower mark. For each run the burner was started and gas was burned off until the level reached the lower mark. Simultaneously, the flame was placed under the flared copper inlet to the heat exchanger; the timer was started. The gas was allowed to burn until the level reached the higher mark at which time the flame was removed and the timer was stopped.

Verification tests were conducted to determine the water temperature stratification in the styrofoam container, heat capture ability, and comparison of a burner designed to work within a wide BTU range.

The stratification test was accomplished by placing four thermistor probes at different points in the water. One provided a digital display with the capability to store the minimum and maximum readings in memory until reset. The heat capture test was done using a Bunsen burner and propane with a known BTU value which was provided by vendor.

The comparison test was conducted, using propane, acetylene and Carbo-hydrogen™ (COH_2) gases.

Test Data

Test A. Propane 1 liter of propane at 5 psig. 4 lbs. of water, 2.9 lbs of copper. Burn time = 2min. 42 sec. to 3 min 39 sec.

	Start Temp °C	End Temp °C	ΔT °C	ΔT °F
1	23.5	34.2	10.7	19.26
2.	33	41.9	8.9	16.02
3.	19	28.5	9.5	17.10
4.	27.4	37.1	9.7	17.46
5	21.5	31.7	10.2	18.36
6.	29.3	40.5	11.2	20.16
7.	23.1	32.9	9.8	17.64
8.	30.8	41.6	10.8	19.44

Average ΔT = 18.18 °F

Test B. Acetylene 1 liter of acetylene at 5 psig., 4 lbs. of water, 2.9 lbs of copper. Burn time = 1 min. 41 sec. to 2min. 19 sec.

	Start Temp °C	End Temp °C	ΔT °C	ΔT °F
1	16.8	22.8	6.0	10.8.
2.	20.7	26.9	6.2	11.16
3.	24.6	30.1	5.5	9.9
4.	26.7	33.1	6.4	11.52
5.	30.2	37.6	7.4	13.32
6.	19.5	26.4	6.9	12.42
7.	23.8	30.6	6.8	12.24
8.	27.5	34.8	7.3	13.14

Average ΔT = 11.81 °F

Test C. Carbo-hydrogen (COH_2) 1 liter of Carbo-hydrogen (COH_2) at 5 psig., Burn time ≅ 1min. to 2 min. 10sec.

	Start Temp °C	End Temp °C	ΔT °C	ΔT °F
1.	18.7	21.0	2.3	4.14
2.	19.9	22.2	2.3	4.14
3.	20.6	22.8	2.2	3.96
4.	20.2	22.3	2.1	3.78
5.	21.0	22.9	1.9	3.42
6.	20.9	23.4	2.5	4.5
7.	22.3	24.6	2.3	4.14
8.	23.3	25.5	2.2	3.96

Average ΔT = 4.004 °F

CALCULATIONS:

The calorimeter contains four pounds of water. In addition, the copper heat exchange coil contain 2.9 pounds of copper. In order to determine the amount of heat transferred to the calorimeter, the "effective specific heat" of the water plus the copper must be calculated.

Specific heat of H_20 = 1.0 BTU/°F•lb
Specific heat of copper = 0.09305 BTU/°F•lb

Effective specific heat =
(4 lb X 1.0) + (2.9 lb X .09305)
~ 4.27 BTU/°F

Now the total heat transfer in BTUs can be calculated from the average temperature rise (ΔT_{avg}) from each test run.

BTU rise of the calorimeter is equal to the effective specific heat times the delta-T average

Test A. Propane

Propane = 4.27 X 18.18°F=77.63 BTU

Pressure correction:

$P_1/P_2 = V_2/V_1$

19.7 / 14.7 X 1 = 1.34 liters @ 1 atm

BTU/liter = 77.63 / 1.34 ~ 57.93 BTU/liter @ 1 atm

To calculate the BTU content of one cubic foot:

BTU/ft^3 = 28.316 liters/ft^3 X 57.93 BTU/liter ~ 1640.4 BTU/ft^3

The efficiency of heat capture can be calculated using the known heating value of the propane used in Run A.

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1640.4/2530 = 64.8%

Test B. Acetylene
Acetylene = 4.27 X 11.813°F=50.44 BTU

Correction to 1 atmosphere from 1 liter of gas at 5 psig:

BTU/liter = 50.44 / 1.34 = 37.64 BTU/liter @ 1 atm

To calculate the BTU content of one cubic foot:

BTU/ft^3 = 28.316 liters/ft^3 X 37.64 BTU/liter ~ 1065.8 BTU/ft^3

The efficiency of heat capture can be calculated using the average book value for the heating value of acetylene. (Note; The average value is used here because the actual value is unknown,).

1065.8/1447.5 = 74%

Assuming that all techniques used in the calorimetric testing are the same for all gases tested, a relative value of BTU content can be calculated using the ΔT of each test. (It is noted that there are variations that enter into each test and that the results will very because of the different heating values of each gas.)

Since the propane used has a known heating value of 2530 BTU/f^3, it will be used as the standard in the relative calculations.

$$\frac{\Delta T \text{ (acetylene)}}{\Delta T \text{ (propane)}} = \frac{X \text{ BTU/ft}^3}{2530 \text{ BTU/ft}^3}$$

X = 1643.94 BTU/ft^3
(relative to Run A for propane)

This value is high compared to the book value, which would indicate a difference in heat capture during the calorimetric testing.

Test C. Carbo-hydrogen™ gas

Carbo-hydrogen =
4.27 X 4.005 °F = 17.10 BTU

Correction to 1 atmosphere for 1 liter of gas 5 psi gauge.

BTU/liter = 17.10 / 1.34 = 12.76 BTU/liter @ I atm

To calculate the BTU content of one cubic foot:
BTU/ft^3 = 28.316 liter/ft^3 X 12.76
BTU/liter = 361.35 BTU/ ft^3
Since the heating value of the propane gas is known for Test A, a relative comparison with test A (propane) yields the following:

$$\frac{\Delta T \text{ (carbo-hyd.)}}{\Delta T \text{ (propane)}} = \frac{X \text{ BTU/ft}^3}{2530 \text{ BTU/ft}^3}$$

X = 557.35 BTU/ft^3

A similar calculation can be made using the value for acetylene from the reference book.

4.005/ 11.813 = X / 1447.5

X = 490.75 btu/ft^3. From the relative comparisons, the calculations give a low and high value for Carbo-hydrogen gas heating value of:

490.75 BTU/ft^3 (low)
557.35 BTU/ft^3 (high)

These values compare favorably with the previous calorimetric testing. The previous input energy versus output energy calculation are redone using these new BTU figures.

The temperature rise of the solution or generating equipment was not taken into account for efficiency calculations. Only electrical input energy was used.

However, as described in our testing in *IE#*10, there is a significant heating of the water in the gas generator, so this will boost the effective over-unity efficiency.

INPUT **ENERGY**
Electrical input: 40 amps @ 24 volts
Time: 1-hour
Power = 40 amps X 24 volts
Energy = 960 watt-hours

Conversion of Watt-hours to BTUs
Conversion factor for watt-hours to BTU:
3.413
Power = 960 watt-hours
Energy In =
960 watt-hours X 3.413 = 3276.5 BTU

OUTPUT ENERGY
Gas output: 240 liters/hour
Conversion factor for liters
to cubic feet 0.035316
Gas output in ft^3 =
240 liters X 0.035316 ft^3/liter = 8.48 ft^3

Energy content of COH_2 gas =
490.75 BTU/ft^3 (acetylene ref.)
Energy Out (low) = 8.48 ft^3 X
490.75 BTU/ft^3 = 4161.56 BTU

Energy content of COH_2 gas =
557.35 BTU/ft^3 (propane ref.)
Energy Out (high) = 8.48 ft^{3}X 557.35
BTU/ft^3 = 4726.33 BTU

EFFICIENCY (low)

$$\frac{\text{Energy Out}}{\text{Energy In}} = \frac{4162 \text{ BTU}}{3277 \text{ BTU}} = 127\%$$

EFFICIENCY (high)

$$\frac{\text{Energy Out}}{\text{Energy In}} = \frac{4726 \text{ BTU}}{3277 \text{ BTU}} = 144\%$$

Comment by David Wallman:

The latest calorimetric testing brings up some interesting issues related to heat capture efficiency and differences among the gases tested. Obviously, the ideal way to test a gas would be through the use of a bomb calorimeter. Given that we do not have access to that equipment, the Styrofoam container with a copper heat exchanger appears to be a reasonable substitute, especially when a relative delta-T comparison is made using a gas with a known calorific value.

As might be expected, there are differences in the latest tests involving propane, acetylene, and carbo-hydrogen gas (COH_2).

During the testing of propane and acetylene, the calculated heat capture efficiency ranged from 64% to 74%. For each individual gas tested, the average heat capture was very consistent, with variations in the range of plus or minus 1-2%. This was true for carbo-hydrogen gas also.

The question is: Why does the capture efficiency between propane and acetylene show a 10% variance? I believe the variation is related to the burn characteristics of each gas, the calorific value of each gas, and the constant air volume drawn into the calorimeter during the tests (same for all gases tested).

Propane burns with a vigorous blue flame when the burner was adjusted for optimum combustion. Acetylene burns with an extremely vigorous white hot radiant flame, while carbo-hydrogen gas burns with a gentle blue flame. In addition, the gas orifice on the burner had to be reduced significantly for the carbo-hydrogen gas in order to produce a reasonable flame for testing. The same volume of propane and acetylene would each burn much longer (when adjusted for maximum burn time) than would the same volume of carbo-hydrogen gas.

Air/fuel ratio may play a part in the heat capture efficiency also. Without providing an air mixture, the propane burned with a very yellow flame; acetylene burned with a red-yellow flame and produced much soot; carbo-hydrogen burned with a blue, needle-sharp flame about four-inches in length. Remember, carbo-hydrogen contains (COH_2).

The 43rd edition of *Handbook of Chemistry and Physics* (CRC Press), indicates the following air/fuel ratios: Propane (23.8:1); Acetylene (11.9:1); Blue-water gas (2.28:1) (similar to carbo-hydrogen gas.

This indicates an extreme difference in burn characteristics. Given the differences in burn characteristics and calorific values of the gases under test, it is reasonable to assume that by using the same airflow rate and volume in the calorimeter, it would be easier to capture a larger percentage of the heat from the acetylene flame (adjusted for optimum combustion) than from a gas with a much gentler burn characteristic. The ambient air would have much less effect on a vigorous, high-heat content flame.

If this is true, the calorimeter used for these latest tests would seem to favor gases under test that have a high calorific value. The results of these tests do compare very favorably with the previous tests (*IE#*10), which used a completely different form of calorimeter. in fact, the latest results are almost identical, which indicate a calorific value for carbo-hydrogen gas of 500-550 BTU/ft^3. Still, the ideal test would be in a bomb calorimeter.

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A Letter on Aqua Fuel™ from Richardson Energy, Inc.

1496 Giles St. NW, Palm Bay, Florida 32907 (407)-723-1163; Fax (407)-723-4114

Dear Dr. Mallove,

It is very exciting to see the different work involving the use of the electric arc and your coverage in *Infinite Energy.* The articles lead one to believe that we are not only on the threshold of a new energy system, but of an entirely new form of chemistry and applied physics.

I am including drawings and photos of the equipment used to develop the one KwH and 80 cubic feet figures [*Ed. Note: Bill Richardson says that 1 KwH of electric energy input produces 80 ft³ of AquaFuel™ gas.*]. The drawings will help those who wish to build a more advanced unit than the fishbowl demonstration setup [depicted on the cover of *IE#9* and *#10*]. The fishbowl unit was built for show-and-tell at a local school by Rob Jaeger.

The main concern I have with people experimenting with AquaFuel™ is the mixing of air in any accumulator they chose to store the fuel gas. AquaFuel™ is, by itself, non-flammable. Only when mixed with five parts air or one-to-one with pure oxygen will the fuel gas become combustible. Compression to over 3,500 psi has been achieved without mishap.

In designing any production system, it is important to provide a tight vacuum retaining method of capturing the gas as it is produced. The column above the arc is connected to the threaded input of a compressor acting as a vacuum pump. A column of water is pulled above the arc area and allowed to stand for one hour. If the system is tight, this water column will remain a the same level showing no air entering the system. ***Any leaks in the system will introduce air to the fuel gas in storage and lead to a possible explosion.***

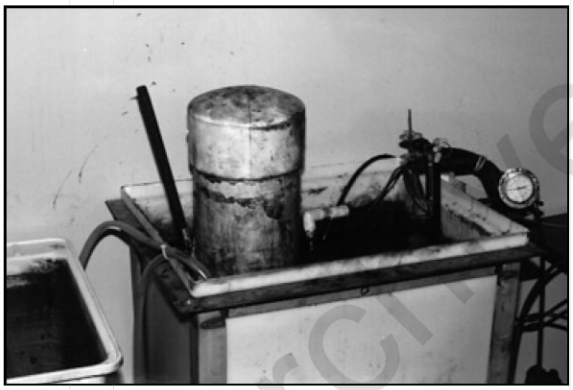
As I said, AquaFuel™ is not combustible until it is mixed with five parts air. Any engine modifications must include a reduction in the air fuel ratio expected from a hydrocarbon fuel. Gasoline requires a fourteen-to-one air/fuel ratio. The 5/1 ratio lends itself to reductions in NO_X production.

The drawings also show the need for a filter between the arc column and the intake of the compressor. There is a small amount of lose carbon floating in the water from the rods which will damage the compressor valves if not filtered out. Also, the filter acts as a water trap since pulling a vacuum on the surface of hot water will produce steam. The resulting steam can water-down the lubricating oil of the compressor quicker than condensation from compressing air.

The object is then to produce clean, dry AquaFuel™ to be compressed for engine use or the cutting of steel. Our trademark name for acetylene replacement is AquaLene™.

I will give you an idea of my views on the articles you published in the No. 10 issue. I am glad to see the coming of age of the electric arc and it's brave new world.

In the "COH_2" article there is no analysis of the gases produced by striking an arc in biomass. In a letter to me, Mr. Dammann and Mr. Wallman complained of engine damage while running under load on their gas product. A gas analysis of their product will, no doubt, include large amounts of acetylene. Acetylene is highly explosive in nature and needs to be mixed in acetone to be stable.



AquaFuel™ generation apparatus showing plastic collection chamber *(Courtesy: Richardson Energy, Inc.)*

While at the NASA labs having the analysis completed, the chemist mentioned the presence of acetylene is common in oil - filled transformers. The presence and amount of acetylene is an indication of a short circuit (arcing) of the windings. There are also patents on the use of arc and oil floating on water to produce acetylene.

Your comment about the use of pure hydrogen and oxygen in cutting steel is correct. However, a mixture of hydrogen and carbon monoxide will not cut steel. The use of "Water or City Gas" in this country for home heating and lighting goes back many years. This fuel gas was available to industry working with steel from the same sources that supplied home owners. And as our friends in the patent office are so found of saying, "anyone experienced in the art would have thought to use Water Gas to cut steel with oxygen." The fact that acetylene generators were in place for the steel industry shows a preference in performance. The lower cost of Water Gas, as opposed to acetylene, would have led to the development of Water Gas over acetylene if it could do the job.

The wide-scale use of natural gas came into play after the development of the vast pipeline network to deliver this well-head product to the major cities. The recent addition of natural gas has allowed the use of this fuel as a replacement for acetylene. Large industries that fabricate steel structures prefer a piped-in fuel gas to the storage of cylinders of acetylene.

Under the heading of calorimetric testing of COH_2, the use of a Bunsen burner was tried. I also tried to use a Bunsen burner to heat water. The problem I had was the burning of my fuel gas and air in the burner melted the aluminum stand pipe portion. Natural gas, which is the fuel gas on which the Bunsen burner was designed to run, would not have melted the aluminum stand pipe. I had to use a cutting torch with a fuel gas tip to stop this problem.

The input energy of 40 amps @ 24 volts [*Ed. Note: The conditions used by D_W Research*] helps to prove my point of low arc load to the power supply. Since the electrodes are burning unevenly, the power supply is DC. The resistance of this system is then R=E/I. Now 24 volts divided by 40 amps is 0.6 ohms for the total circuit, including the leads, connections, electrodes, and the arc itself. The common belief is that this circuit is a high resistance load to the power supply due to the presence of the water.

The theories supplied by Gerhard Knapp are, to say the least, interesting.

He begins by stating that from his calculation, 80 cubic feet of AquaFuel™ contains 1.25 pounds of carbon. Where did the extra 0.25 pounds come from? As I stated, only one pound of carbon (graphite is the correct term) rods were used in the production unit. Of this pound, only 60% became fuel gas. The balance was found in pieces of unused rod about 10% of the original length. Also, fine particles from the rods were floating in the water. The use of a filter to prevent these particles from entering the compressor is necessary. So at best, ten ounces of the pound is used in the formation of the gas, not 1.25 pounds.

The set of three pictures shows the equipment used to produce the 80 cubic feet of fuel gas for the power consumption of one kilowatt-hour. The one kilowatt-hour does not include the energy needed to compress the fuel gas into the AquaLung cylinders. The picture of the tub with the column shows the black residue left from the process. A "C" clamp holds a float gage in place to control the low pressure compressor connected to the two (red) storage tanks. Under the table is the AC welder used to supply the arc. The dial is on a thermometer to tell me when the water has reached 160 degrees F. Next to the red tanks is the high pressure compressor used to fill the AquaLung cylinders. This is to show that the fish bowl did not provide the data.

Knapp's conclusion that the 80 cubic feet

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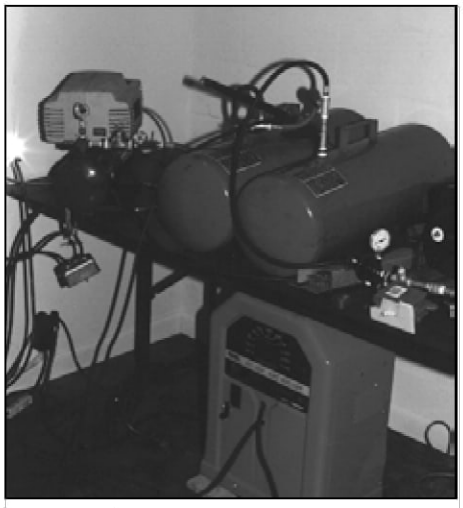


AquaFuel™ collection apparatus showing compressor (L) and collection tanks(welder below table) ***(Courtesy: Richardson Energy, Inc.)***

contains only 23,000 is based on a confusing use of the BTU per pound number used in two places in his calculation, At one point he says the process produces the classical product of water gas. A combination of hydrogen and carbon monoxide. He then goes on to use a higher value for the energy content of CO than 4,344 BTU to prove the point of carbon being the main source of energy in the fuel. If we replace any references to carbon at 14,000 BTU with CO's 4,000 BTU, as in water gas, his figures do not balance.

However, the figure of 23,000 BTU does approach the correct value based on the output of the generator set. What Knapp has shown is that the concept of carbon monoxide being a major component of AquaFuel™ is not correct based on performance.

The reference to a lean air/fuel ratio based on the presence of 7.1% oxygen in the exhaust is also incorrect. When gasoline is burned lean in a piston engine, high cylinder head temperatures result. The exhaust temperature of the Briggs test show a lower combustion temperature which eliminates NO_X formation as shown by gasoline.

AquaFuel™ will not run an engine with large amounts of air in the cylinder. Since it is lighter than air, the presence of excess air flushes the fuel from the cylinder. The loss of fuel from the carburetor is at least 10% of that supplied. Since the engine was not modified for the test, other than introducing the fuel gas to the carburetor intake, incomplete use of the fuel gas was the result. Also, the point of spark firing is before top dead center. AquaFuel™ burns at a much higher rate of combustion than does gasoline. This means a major portion of the energy in the fuel is wasted as the piston has not reached top dead center. A firing point of one degree after top dead center would have reduced fuel consumption and increased run time.

It is interesting to note that the 80 cubic feet of gas contains, according to the Knapp analysis, 22,753 BTU developed from 3,413 BTU of electrical energy. A ratio of 6.66/1. By eliminating the problems of the Briggs engine set, better use of the fuel energy will be achieved. Also, technical points beyond the scope of this paper will prove the concept of the closed loop system.

These points are based on actual experience, not from trying to use limited information which can be misleading. A fine effort, nonetheless, by Mr. Knapp.

I liken the people who believe that AquaFuel™ is the product of the incomplete combustion of a hydrocarbon to those standing on the dock, waiting for Columbus to fall of the edge of the world. How upset they must have been when Columbus returned with the true facts. Not that they believed him.

Just for fun, let's review our sixth grade science facts about combustion. In order to make fire work we need three items: Fuel, Heat, and Air.

Fuel: a substance that will burn. Heat: from the kindling point to start combustion and then to maintain combustion. Air: to provide oxygen to support combustion.

Fuel: Graphite rods are not [easily] combustible. The manufacturer of these rods states this fact. Carbon in pure form is an element. Pure elements due not burn [easily]. Any compounds used to form the rods are cooked out in the production process, so as not to introduce impurities into molten metals being heated by the arc. No sulfur or any other pollutants are in graphite rods. Graphite is not coal.

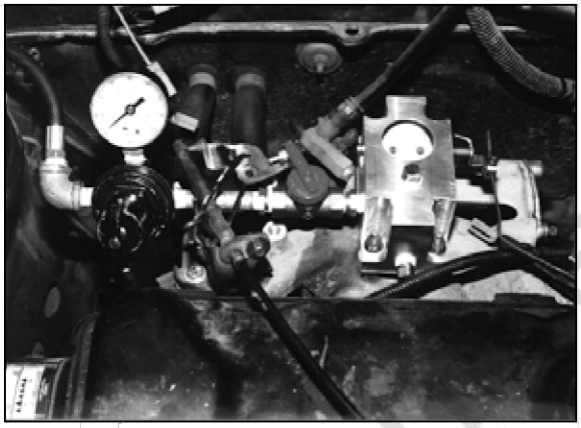
Air: To support combustion we need oxygen. Air cannot reach the arc since it is under water. The disassociated oxygen cannot combine with the carbon due to the extreme heat of the arc. Combustible materials have a temperature range they function within. The three elements are at too high an energy level to form simple combustion.

Heat: The electric arc is not fire. Fire is the product of combustion. The arc is the result of pure electrons being exposed as they jump the gap. The heat is the nuclear signature of the arc.

Without heat, fuel, and air we cannot have combustion. So the carbon cannot burn incompletely to form carbon monoxide.

The proof of the following points is in the NASA report. Remember, we are starting with distilled water (hydrogen and oxygen) and graphite (conductive carbon in pure form). We have no hydrocarbons present—not in the graphite rods or in the distilled water. The water is held in a metal or glass tank.

A key to this process is in the nitrogen. I have had six different lab analyses performed on AquaFuel™, three tests on the same lot sample. The amounts of nitrogen very as much as 35% by content. The oxygen does not track in this test in the same manner. If there was that much nitrogen in the fuel, the exhaust would contain much higher amounts of NO_X than shown in the Briggs & Stratton report.



Automobile engine fittings for AquaFuel™ adaptation. ***(Courtesy: Richardson Energy, Inc.)***

Also, the assumption by Dr. Rowe that some of the air above the water was included in the compressed fuel gas would be dangerous since oxygen from the air would be in the cylinders. Great pains are taken to prevent outside air from entering the fuel storage vessel.

This item called nitrogen in the report is combustible. If it wasn't, the engine performance would never be so close to that of gasoline. The item listed as nitrogen is a new molecule of carbon and hydrogen formed by the arc that will burn completely to water vapor and carbon dioxide.

Present day chemistry only understands the reduction of existing large molecules into smaller more useful compounds. For example, oil to gasoline. This follows the belief that only the second law of thermodynamics applies, and that energy is a consumable.

The arc process is two hundred years ahead of present day chemistry. The arc does not reduce but it builds molecules from the hydrogen, oxygen, and carbon. Look at the NASA report. All of these compounds are being formed by the arc in gaseous form. The water in the tank, from other experiments in this issue has an increase in the amounts of iron that is also not found in the rods or the water.

The nitrogen in the gas is formed by the combining of a carbon atom with two hydrogen atoms. The result is combustible unlike nitrogen. The two compounds have the same [mass] number of 14. Propane and carbon dioxide each have the [mass] number of 44, yet one is combustible and the other is not.

The arc is a stream of high energy electrons surrounded by water. The heat generated by pure electron energy disassociates the water into hydrogen and oxygen. The elements are forced into the electron stream by the hydraulic pressure of the surrounding water. If they were not forced into the stream, the two gases would leave the surface of the water separated from

each other.

Once in the electron stream, these atoms lose their electrons and become protons only, as in the hydrogen atom having only one proton. The oxygen atom loses one or more of its electrons to expose it nucleus.

Now, there is a major misunderstanding as to how the carbon in the rods becomes heated. We know that the end of a rod will glow white hot where the arc jumps the gap. But a few inches away the rod is cool to the touch. The assumption is that the flow of current through the rod causes this heating effect until the rod become incandescent.

If resistance in the rod caused heating, then the whole rod would be heated equally from the point of contact with the power supply to the arc gap. This is the situation in a light bulb filament. The tungsten heats because of the current passing throughout its length. As the temperature increases, the resistance also increases, producing more heat and then light emission.

The carbon's reaction to current flow is the opposite of tungsten's. Carbon when heated has a drop in resistance, a negative coefficient of resistance. The more it is heated the lower the resistance to the current flow. So at the point where the arc forms, the bright light is not the product of resistance, as would be the case of tungsten with its positive coefficient of resistance.

The heating effect must come from the loss of electrons. We know that one way to describe heat is by stating that the vibration of an atom represents its heat level. More vibration energy, the greater the heat energy.

When a object that is balanced loses a portion of its mass, vibration increases. We see this in a car tire and wheel. New tires are balanced to element vibration. If a wheel weight is lost, the tire and wheel go out of balance. This causes a vibration to be set up in the pair. This vibration will ruin a tire if not but back in balance.

The carbon atoms in the rods are in balance until they lose an electron. This loss of one or more electrons by the pull of the EMF increases the atom's vibration. At some point the atoms lose enough electrons to increase the vibration to emit light from the nucleus and remaining electrons. This heating breaks lose the carbon atom from the rod end but does not heat the rod itself.

When the carbon atom breaks free and enters the electron stream, it has lost enough of its electrons to expose the core or nucleus to other free protons from the hydrogen atom. We know that carbon and hydrogen are found in many combination s in nature. This shows an affinity between the atoms that goes beyond just proton and electron balance. The exposed core of the carbon atom collects the free proton of the hydrogen atoms and being more positive than the electron stream are expelled into the surrounding water. On the way out of the stream, free electrons balance the nucleus and provide a stable or balanced element.

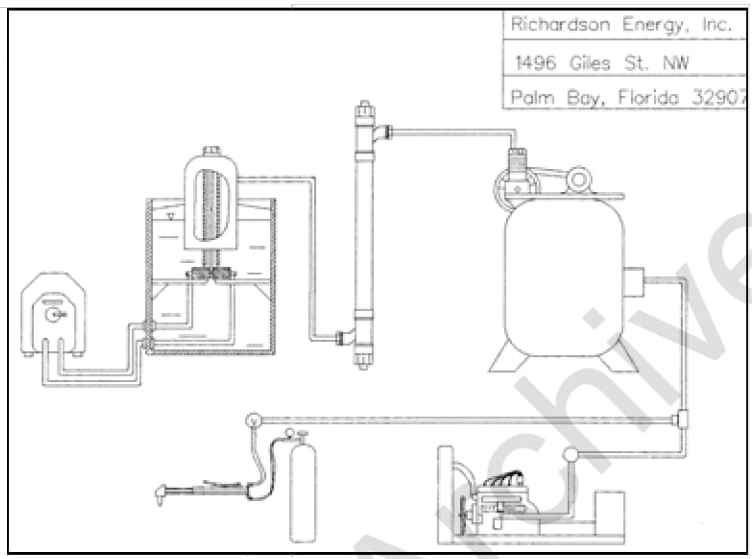
Depending on how many electrons are lost by both the carbon and oxygen atoms in the presence of free hydrogen protons, any combination of protons in a nucleus can form. This explains the excess of nitrogen in the fuel gas and its ability to burn. It is not nitrogen but an element of similar protons and electrons.

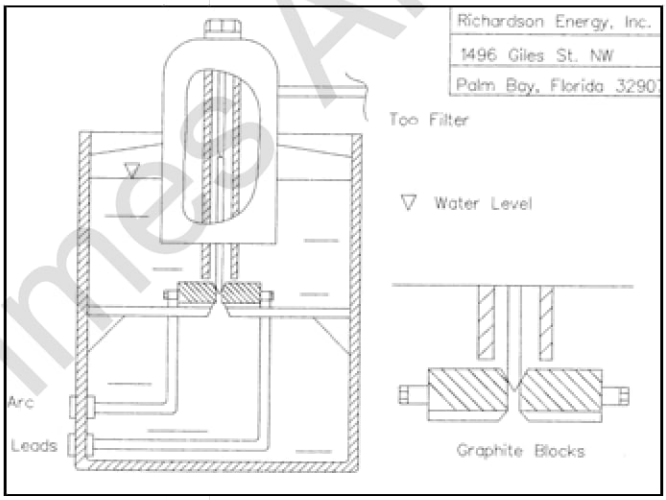
Combination of oxygen and carbon in this environment of the electron stream has a far higher energy level than byproduct carbon monoxide. This would explain why AquaFuel™ has a very strong smell , while hydrogen and carbon monoxide are odorless.

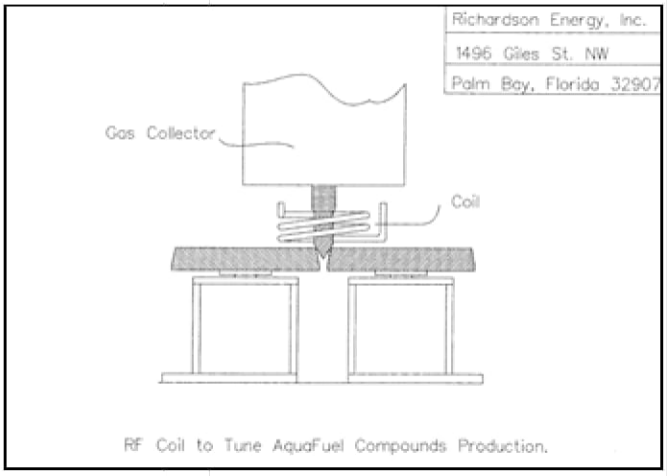
What we are then doing is disassembling the atoms and recombining them into new elements. This is evident in the products from in the NASA report. Since these products are not formed from distilled water and carbon by current chemistry, the arc must form them with a new chemistry based non subatomic action.

This leads me to the conclusion that since the arc is rearranging the elements and that the arc is a generator of radio frequency, the introduction of an outside RF could be used to tune the elements and produce designer-atoms from water and carbon. The mass spectrometer numbers point to a harmonic of the molecular products found in the fuel gas.

Another test to confirm the fact that AquaFuel™ is not a mixture of hydrogen and carbon monoxide was conducted. Simple balloons were filled with purchased hydrogen, carbon monoxide, acetylene, and helium. The last balloon was filled to the same diameter as the others with AqauFuel™. The pure hydrogen balloon deflated in two hours. CO in eight hours. Mixture of hydrogen and CO, four hours. Acetylene, two days. Helium, two weeks. The AquaFuel™ required six months to fully deflate. The gases still in the balloon three months into the test were flammable.







The electric arc has been seen as the tool of backyard mechanics and of little importance. In fact, we will see that the arc is the cornerstone of a whole new world of clean power and biodegradable chemistry, far superior to present knowledge. It is a good thing that they did not close the patent office when the steam engine was invented!

William H. Richardson

New Energy Times Archive

Cold Fusion and New Energy: Coping with an Obstructionist U.S. Patent Office

The most difficult obstacle continues to be Washington itself.....

Infinite Energy* Magazine received these exclusive "leaks" from its *"PTO Insider"*— a strong advocate of cold fusion and new energy, who now works within the US Patent and Trademark Office. —*EFM

I will use the "PTO Insider" pseudonym, in all future Patent Office leaks to the press.

Enclosed is a memo that you may be interested in sharing with *Infinite Energy* readers. Knowing the people you are dealing with can help in an appeals strategy.

After reviewing the *Patent Quarterly*, I find only one appeals case involving cold fusion! Ex parte Dash (27 USPQ 2d 1481) from 1992 is a sad example of a half-hearted appeal attempt as well as a poorly written patent. We need more serious cold fusion applicants to take the plunge into an appeal, learning from the revelations of the previous case, to break through the cold fusion patent barrier. Perhaps the publication of the Ex parte Dash case in your magazine will help aspiring patentees to avoid some of the obvious pitfalls. (I'll send a copy if you don't have one already.)

Recently, I sent Storms' article "Review of the 'Cold Fusion' Effect" from *J. of Sci. Exploration* (V. 10, No. 2, 1996) to Director Garrett and a few examiners, with a cover letter quoting Storms, "much information is proprietary and not available to the public because patent protection is not being granted in the U.S." However, I don't think I was able to change any policy here with one article. There is a legal and logical chess game that has to be followed in order to gain the reviewer's allowance.

The appeals case Ex parte Dash reveals that Claim 1 was designed to describe electrolysis in such general terms that the examiner was able to use the ultimate insult, an Edison patent (1,016,874), as a prior art rejection, besides von Sturm (4,146,446) and Spengler (3,446,725), which are all plain electrolysis patents.

If the applicant or appellant is insistent on describing and claiming cold fusion, it has to be unique (novel) and unobvious. Since there are hundreds of articles now published on cold fusion, that puts even more burden on the applicant to be creative in the Patterson or MIT sense, to avoid the most common types of rejection. With a 102 rejection, Dash and Keefe apparently didn't realize that their claimed method was the same as had been already published by Jones in *Nature* (V. 338, p. 737, 1989). Somebody didn't read the literature first. The Ahern et al. patent from MIT (5,411,654) is a good example of how specific and limiting the claims have to be to gain allowance, without mentioning cold fusion in the claims.

There is a sticky point that examiners here feel is not easily resolved. That is, how much experimentation is necessary to obtain successful cold fusion results. If the applicant can be convincing in his methodology and lab records (if needed) that the experiment is as successful and predictable as Patterson (5,372,688, etc.), then that question will not be a problem. However, some admitted experimentation is okay as long as it is not determined to be "undue experimentation."

I encourage the detailed study and analysis of Ex parte Dash to all those applicants who wish to follow the couple of successful cold fusion patentees cited above. One comment (on p.7) that reveals the chink in the armor of the appellate judges is, "We are not unaware that we are sustaining rejections under lack of enablement based on reasons which also apply to the prior art. If appellants overcome the lack of enablement of their claims, they will necessarily overcome the lack of enablement of the references."

These guys know they are in a bind when they are using the same references as prior art as the references they don't believe are functional. It is actually very embarrassing to them to have to admit that. Therefore, they are willing to be convinced from a number of directions. Either the reference procedure is proven effective or the appellants' procedure is proven to have utility. In fact, the above comment holds the promise that the whole field of cold fusion will be enabled as soon as the first crusader gets through the door to win the princess' hand.

Lastly, be careful what you publish. It can and will be used against you if you wait more than one year to apply for a patent on the method or apparatus. Uniquely describe the process in such scientifically precise terms that the claim covers you but the examiner will have a tough time finding any prior art, much less a 101 utility rejection. For example, "anharmonic" is a great descriptor that limits the claim (see Ahern patent Claim 1), specifically for comparing it to other prior publications.

Someone will succeed in the U.S. besides Patterson and Ahern. Then, many others can follow when the field is enabled. I'll keep trying from the inside to break through the new declared motto of the USPTO, "To Help Our Customers Get Patents." I encourage others to do so as well. Use the force of this motto to get more help when necessary to embarrass the examiner and his supervisor. If all else fails, a "file wrapper continuation" (FWC) can always be filed to prolong the life of an application, even after final rejection.

Sincerely,

PTO Insider (December 1996)

In another note, the PTO Insider give us another operational hint:

"To all those cold fusion inventors with unprotected discoveries, have any of them at least obtained a SIR?? If they refuse to do a CIP, DIV, FWC, or appeal after 2 rejections, the SIR is the easiest document (protecting and invention) to obtain. Please advertise this PTO service."

PTO Insider

Editor's Comment: The "PTO Insider" is referring to the Statutory Invention Registration (SIR) Program:

Statutory Invention Registration (SIR Program)

- Effective May 8, 1985
- Requirements set forth in 35 U.S.C. 157 and 37 CFR 1.293 - 1.297
- 37 CFR 1.294 authorizes Commissioner to publish SIR without examination, except as required to determine:
  - * if the subject matter of the application is suitable for publication,
  - * if the requirements for publication are met, and
  - * if the requirements of 35 U.S.C. 112 and 37 CFR 1.293 are met
- Nonprovisional application

As set forth in 37 CFR 1.293, a SIR request may be made any time during pendency and must include:

=> request signed by applicant and assignee, or attorney of record

=> waiver of right to receive patent on the invention

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=> fee - 37 CFR 1.17(n) or (o)
=> statement that application meets the requirements of 35 U.S.C. 112
=> statement that application complies with the formal requirements for printing

• All SIRs are determined by Group 2200 - if the application is involved in a pending interference, no decision is made on the SIR request until the interference proceedings are concluded

• Advantages of a SIR
* Like patent for all defensive purposes
* No maintenance fees
* Can be involved in interference
* Prior art under all sections of 35 U.S.C. 102
* Classified like a patent
* Usable as a reference as of its filing date

Editor's Comment: The *PTO Insider* sent another hint:

"Please reprint this section from the MPEP (Manual of Patent Examining Procedure). I believe that a special status for a cold fusion application will help it. The interview is included in the process, which forces the examiner to help the applicant. Section VI applies to cold fusion inventions "discovering new energy resources." Lastly, Section VII(1) restricts the examiner's search to "the subject matter encompassed by the claims,' which helps the applicant! The examiner's supervisor also has to review and administer the prosecution."

PTO Insider

Editor's note: Highly relevant sections are <u>underlined</u> by *Infinite Energy*:

708.02 Petition To Make Special [R-1]

>37 CFR 1.102 Advancement of examination.

(a) Applications will not be advanced out of turn for examination or for further action except as provided by this part, or upon order of the Commissioner to expedite the business of the Office, or upon filing of a request under paragraph (b) of this section or upon filing a petition under paragraphs (c) or (d) of this section with a verified showing which, in the opinion of the Commissioner, will justify so advancing it.

(b) Applications wherein <u>the inventions are deemed of peculiar importance to some branch of the public service and the head of some department of the Government requests immediate action for that reason, may be advanced for examination.</u>

(c) <u>A petition to make an application special may be filed without a fee if the basis for the petition is the applicant's age or health or that the invention will materially enhance the quality of the environment or materially contribute to the development or conservation of energy resources.</u>

(d) A petition to make an application special on grounds other than those referred to in paragraph (c) of this section must be accompanied by the petition fee set forth in 1.1 7(i).

New applications ordinarily are taken up for examination in the order of their effective United States filing dates. Certain exceptions are made by way of petitions to make special, which may be granted under the conditions set forth below.

I. MANUFACTURE

An application may be made special on the ground of prospective manufacture upon the filing of a petition accompanied by the fee under 37 CFR 1.17(i) by the applicant or assignee alleging under oath or declaration:

(1) The possession by the prospective manufacturer of sufficient presently available capital (stating approximately the amount) and facilities (stating briefly the nature thereof) to manufacture the invention in quantity or that sufficient capital and facilities will be made available if a patent is granted;

If the prospective manufacturer is an individual, there must be a corroborating affidavit from some responsible party, as for example, an officer of a bank, showing that said individual has the required available capital to manufacture;

(2) That the prospective manufacturer will not manufacture, or will not increase present manufacture, unless certain that the patent will be granted;

(3) <u>That affiant obligates himself or herself or the prospective manufacturer, to manufacture the invention, in the United States or its possessions, in quantity immediately upon the allowance of claims or issuance of a patent which will protect the investment of capital and facilities.</u>

The attorney or agent of record in the application (or applicant, if not represented by an attorney or agent) must file an affidavit or declaration to show:

(1) That the applicant or assignee has made or caused to be made a careful and thorough search of the prior art, or has a good knowledge of the pertinent prior art; and

(2) That the applicant or assignee believes all of the claims in the application are allowable.

II. INFRINGEMENT

Subject to a requirement for a further showing as may be necessitated by the facts of a particular case, an application may be made special because of actual infringement (but not for prospective infringement) upon payment of the fee under 37 CFR 1.17(i) and the filing of a petition alleging facts under oath or declaration to show or indicating why it is not possible to show; (1) that there is an infringing device or product actually on the market or method in use, (2) a statement by applicant's attorney or agent registered to practice before the PTO to show, (3) that a rigid comparison of the alleged infringing device, product, or method with the claims of the application has been made, (4) that, in his or her opinion, some of the claims are unquestionably infringed, (5) that he or she has made or caused to be made a careful and thorough search of the prior art or has a good knowledge of the pertinent prior art, and (6) that he or she believes all of the claims in the application are allowable.

Models or specimens of the infringing product or that of the application should not be submitted unless requested.

III. APPLICANT'S HEALTH

An application may be made special upon a petition by applicant accompanied by a showing as by a doctor's certificate, that the state of health of the applicant is such that he might not be available to assist in the prosecution of the application if it were to run its normal course. No fee is required for such a petition, 37 CFR 1.102(c).

IV. APPLICANT'S AGE

An application may be made special upon filing a petition including a showing, as by a birth certificate or the applicant's affidavit or declaration, that the applicant is 65 years of age, or more. No fee is required with such a petition, 37 CFR 1.102(c). **[Editor's Note: We believe this method was used in the case of the Patterson Power Cell patent process, but Patterson also was successful because his application passed through a particular PTO branch not hostile to cold fusion applicants.—*EFM*]**

V. ENVIRONMENTAL QUALITY

<u>The Patent and Trademark Office will accord "special" status to all patent applications for inventions which materially enhance the quality of the environment of mankind by contributing to the restoration or maintenance of the basic life-sustaining natural elements air, water, and soil.</u>

All applicants desiring to participate in this program should petition that their applications be accorded "special" status. Such petitions should be written, should identify the applications by serial number and filing date, and should be accompanied by affidavits or declarations under 37 CFR 1.102 by the applicant or his attorney or agent explaining how the inventions contribute to the restoration or maintenance of one of these life-sustaining ele-

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ments. No fee is required for such a petition, 37 CFR 1.102(c).

VI. ENERGY

The Patent and Trademark Office will, on petition accord "special" status to all patent applications for inventions which materially contribute to (1) the discovery or development of energy resources, or (2) the more efficient utilization and conservation of energy resources. Examples of inventions in category (1) would be developments in fossil fuels (natural gas, coal, and petroleum), nuclear energy, solar energy, etc. Category (2) would include inventions relating to the reduction of energy consumption in combustion systems, industrial equipment, household appliances, etc.

All applicants desiring to participate in this program should petition that their applications be accorded "special" status. Such petitions should be written, should identify the application by serial number and filing date, and should be accompanied by affidavits or declarations under 37 CFR 1.102 by the applicant or applicant's attorney or agent explaining how the invention materially contributes to category (1) or (2) set forth above. No fee is required for such a petition, 37 CFR 1.102(c).

VII. INVENTIONS RELATING TO RECOMBINANT DNA

In recent years revolutionary genetic research has been conducted involving recombinant deoxyribonucleic acid ("recombinant DNA"). Recombinant DNA research appears to have extraordinary potential benefit for mankind. It has been suggested, for example, that research in this field might lead to ways of controlling or treating cancer and hereditary defects. The technology also has possible applications in agriculture and industry. It has been likened in importance to the discovery of nuclear fission and fusion. At the same time, concern has been expressed over the safety of this type of research. The National Institutes of Health (NIH) has released guidelines for the conduct of research concerning recombinant DNA. These "Guidelines for Research Involving Recombination DNA Molecules," were published in the Federal Register of July 7, 1976, 41 FR 27902 27943. NIH is sponsoring experimental work to identify possible hazards and safety practices and procedures.

In view of the exceptional importance of recombinant DNA and the desirability of prompt disclosure of developments in the field, the Patent and Trademark Office will accord "special" status to patent applications relating to safety of research in the field of recombinant DNA. Upon appropriate petition and payment of the fee under 37 CFR 1.17(i), the Office will make special patent applications for inventions relating to safety of research in the field of recombinant DNA. Petitions for special status should be in writing, should identify the application by serial number and filing date, and should be accompanied by affidavits or declarations under 37 CFR 1.102 by the applicant, attorney or agent explaining the relationship of the invention to safety of research in the field of recombinant DNA research. Petitions must also include a statement that the NIH guidelines cited above, or as amended, are being followed in any experimentation in this field, except that the statement may include an explanation of any deviations considered essential to avoid disclosure of proprietary information or loss of patent rights. The fee set forth under 37 CFR 1.17(i) must also be paid.

VIII. SPECIAL EXAMINING PROCEDURE FOR CERTAIN NEW APPLICATIONS ACCELERATED EXAMINATION

A new application (one which has not received any examination by the examiner) may be granted special status provided that applicant (and this term includes applicant's attorney or agent) complies with each of the following items:

(a) Submits a written petition to make special accompanied by the fee set forth in 37 CFR 1.17(i);

(b) Presents all claims directed to a single invention, or if the Office determines that all the claims presented are not obviously directed to a single invention, will make an election without traverse as a prerequisite to the grant of special status.

The election may be made by applicant at the time of filing the petition for special status. Should applicant fail to include an election with the original papers or petition and the Office determines that a requirement should be made, the established telephone restriction practice will be followed.

If otherwise proper, examination on the merits will proceed on claims drawn to the elected invention.

If applicant refuses to make an election without traverse, the application will not be further examined at that time. The petition will be denied on the ground that the claims are not directed to a single invention, and the application will await action in its regular turn.

Divisional applications directed to the nonelected inventions will not automatically be given special status based on papers filed with the petition in the parent case. Each such application must meet on its own all requirements for the new special status;

(c) Submits a statements that a pre-examination search was made, and specifying whether by the inventor, attorney, agent, professional searchers, etc., and listing the field of search by class and subclass, publication, *Chemical Abstracts*, foreign patents, etc. A search made by a foreign patent office satisfies this requirement;

(d) Submits one copy each of the references deemed most closely related to the subject matter encompassed by the claims; and

(e) Submits a detailed discussion of the references, which discussion points out, with the particularity required by 37 CFR 1.111 (b) and (c), how the claimed subject matter is distinguishable over the references. Where applicant indicates an intention of overcoming one of the references by affidavit or declaration under 37 CFR 1.131, the affidavit or declaration must be submitted before the application is taken up for action, but in no event later than 1 month after request for special status.

In those instances where the request for this special status does not meet all the prerequisites set forth above, applicant will be notified and the defects in the request will be stated. The application will remain in the status of a new application awaiting action in its regular turn. In those instances where a request is defective in one or more respects, applicant will be given one opportunity to perfect the request. If perfected, the request will then be granted.

Once a request has been granted, prosecution will proceed according to the procedure set forth below; there is no provision for "withdrawal" from this special status.

The special examining procedure of VIII (accelerated examination) involves the following procedures:

(1) The new application, having been granted special status as a result of compliance with the requirements set out above will be taken up by the examiner before all other categories of applications except those clearly in condition for allowance and those with set time limits, such as examiner's answers, etc., and will be given a complete first action which will include all essential matters of merit as to all claims. The examiner's search will be restricted to the subject matter encompassed by the claims . A first action rejection will set a 3-month shortened period for response.

(2) During the 3-month period for response, applicant is encouraged to arrange for an interview with the examiner in order to resolve, with finality, as many issues as possible. In order to afford the

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examiner time for reflective consideration before the interview, applicant or his or her representative should cause to be placed in the hands of the examiner at least one working day prior to the interview, a copy (clearly denoted as such) of the amendment that he copy (clearly denoted as such) of the amendment that he proposes to file in response to the examiner's action. Such a paper will not become a part of the file, but will form a basis for discussion at the interview.

(3) Subsequent to the interview, or responsive to the examiner's first action if no interview was had, applicant will file the "record" response. The response at this stage, to be proper, must be restricted to the rejections, objections, and requirements made. Any amendment which would require broadening the search field will be treated as an improper response.

(4) The examiner will, within 1 month from the date of receipt of applicant's formal response, take up the application for final disposition. This disposition will constitute either a final action which terminates with the setting of a 3-month period for response, or a notice of allowance. The examiner's response to any amendment submitted after final rejection should be prompt and by way of form PTO-303 or PTO-327, by passing the case to issue, or by an examiner's answer should applicant choose to file an appeal brief at this time. The use of these forms is not intended to open the door to further prosecution. Of course, where relatively minor issues or deficiencies might be easily resolved, the examiner may use the telephone to inform the applicant of such.

(5) A personal interview after final Office action will not be permitted unless requested by the examiner. However, telephonic interviews will be permitted where appropriate for the purpose of correcting any minor matters which remain outstanding.

After allowance, these applications are given top priority for printing. See MPEP § 1309.

IX. SPECIAL STATUS FOR PATENT APPLICATIONS RELATING TO SUPERCONDUCTIVITY

In accordance with the President's proposal directing the Patent and Trademark Office to accelerate the processing of patent applications and adjudication of disputes involving superconductivity technologies when requested by the applicant to do so, the Patent and Trademark Office will, on request, accord "special" status to all patent applications for inventions involving superconductivity materials. Examples of such inventions would include those directed to the superconductive materials themselves as well as to their manufacture and application. In order that the Patent and Trademark Office may implement this procedure, we invite all applicants desiring to participate in this program to request that their applications be accorded "special" status. Such requests should be in writing, should identify the application by serial number and filing date, and should be accompanied by a statement under 37 CFR 1.102 that the invention involves superconductive materials. No fee is required. The statement must be verified if made by a person not registered to practice before the Patent and Trademark Office. Decisions whether to accord "special" status on the basis of a request will be made by the appropriate Group Director.

X. INVENTIONS RELATING TO HIV/AIDS AND CANCER

In view of the importance of developing treatments and cures for HIV/AIDS and cancer and the desirability of prompt disclosure of advances made in these fields, the Patent and Trademark Office will accord "special" status to patent applications relating to HIV/AIDS and cancer. Applications which have been made special will be advanced out of turn for examination and will continue to be treated as special throughout the entire prosecution in the Patent and Trademark Office.

Applicants who desire that an application relating to HIV/AIDS or cancer be made special should file a petition and the fee under 37 CFR 1.17 (i) requesting the Patent and Trademark Office to make the application special. The petition for special status should be made in writing, should identify the application by serial number and filing date, and should be accompanied by a statement explaining how the invention contributes to the diagnosis, treatment or prevention of HIV/AIDS or cancer. Such statement must be set forth in oath or declaration form unless it is signed by a registered practitioner. The petition will be decided by the Director of the patent examining group to which the application is assigned.

HANDLING OF PETITIONS TO MAKE SPECIAL

Each petition to make special, regardless of the ground upon which the petition is based and the nature of the decision, is made of record in the application file, together with the decision thereon. The Office that rules on a petition is responsible for properly entering that petition and the resulting decision in the file record. The petition, with any attached papers and supporting affidavits, will be given a single paper number and so entered in the "Contents" of the file. The decision will be accorded a separate paper number and similarly entered. To ensure entries in the "Contents" in proper order, the clerk in the examining group will make certain that all papers prior to a petition have been entered and / or listed in the application file before forwarding it for consideration of the petition. Note MPEP § 1002.02 (b), (c), and (j). <

Editor's note: The PTO Insider writes again!:

"Another powerful approach when combined with a "petition to make special" or without, is to encourage inventors to apply for patents themselves, so-called "pro se," they can cite MPEP 707.07(j) and demand help from examiners."

PTO Insider

707.07(j) State When Claims Are Allowable [R-1]

INVENTOR FILED APPLICATIONS

When, during the examination of a pro se case, it becomes apparent to the examiner that there is patentable subject matter disclosed in the application, the examiner shall draft one or more claims for the applicant and indicate in his or her action that such claims would be allowed if incorporated in the application by amendment.

This practice will expedite prosecution and offer a service to individual inventors not represented by a registered patent attorney or agent. Although this practice may be desirable and is permissible in any case where deemed appropriate by the examiner, it will be expected to be applied in all cases where it is apparent that the applicant is unfamiliar with the proper preparation and prosecution of patent applications.

ALLOWABLE EXCEPT AS TO FORM

When an application discloses patentable subject matter and it is apparent from the claims and the applicant's arguments that the claims are intended to be directed to such patentable subject matter, but the claims in their present form cannot be allowed because of defects in form or omission of a limitation, the examiner should not stop with a bare objection or rejection of the claims. The examiner's action should be constructive in nature and when possible should offer a definite suggestion for correction. Further, an examiner's suggestion of allowable subject matter may justify indicating the possible desirability of an interview to accelerate early agreement on allowable claims.

If the examiner is satisfied after the search has been completed that

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patentable subject matter has been disclosed and the record indicates that the applicant intends to claim such subject matter, the examiner may note in the Office action that certain aspects or features of the patentable invention have not been claimed and that if properly claimed such claims may be given favorable consideration.

If a claim is otherwise allowable but is dependent on a cancelled claim or on a rejected claim, the Office action should state that the claim would be allowable if rewritten in independent form.

EARLY ALLOWANCE OF CLAIMS

Where the examiner is satisfied that the prior art has been fully developed and some of the claims are clearly allowable, the allowance of such claims should not be delayed.

.....

Editor's Note: Yet another PTO "mole" or *PTO Insider #2* has come out with helpful, albeit somewhat cryptic, hints to overcome the "perpetual motion" objection:

October 1996

Mr. Mallove,

It has come to my attention that the patent office has prequalified the term perpetual motion to be in accordance with absolute and entire perpetual motion without taking into account structural failure or strength of materials.

The habit has been time and time again used as a traditional remedy for obfuscating the real question: has a quantum effect been discovered in which, despite structural limitations would produce a device capable of operating despite the traditional textbook operation, drawing power from quantum sources or latent spatial or potential energy?

It has not been sufficiently proven what potential energy actually is, nor has it been proven that quantum or potential energies absolutely cannot be converted into kinetic energy, therefore annulling the traditional examiners' and circuit court rulings favoring the examiner.

Because of this scientific type of knee-jerk reaction of the typical examiner, a further inquiry must be made, since the condition of the examiner's mind actually affects the environment around him, the matter should not be relegated to one mere person alone to determine the fate of a potentially useful invention tainted by someone operating from old scientific views, when clearly, a new approach may be used in which holes of reasoning against the traditional viewpoint may even be proposed by the scientists who created them. Therefore, upon an adjunct of judicial notice, I hereby request you and all concerned persons who are in possession of these devices, and who want their applications validated, to submit only the working operational units to the above address as indicated. The working devices will be shown to examiners in the necessary groups and examining corp by those who are designated keepers of them, namely, Thomas Dougherty, Donald Valentine, and Harvey Behrend, all of whom have knowledge and ability in the unconventional energy field.

In the course of examination, proof that an examiner is open to unbiased observation of the material of this nature should be left to a set of examiners who may not be in the same art unit, but are familiar with the topic, and knowledgeable about the forging of these theories and experiments in outside industry. From this viewpoint, it can be seen that this form of supplemental examination proceeding is based upon a fairer criterion to the customer or the Patent Office who wishes the patent granted and is not left up to chance or a skewed, misrepresented, or emotional viewpoint. Democracy is formed by a consensus.

PTO Insider #2

A Letter Sent to Top USPTO Official at the Suggestion of one of the *"PTO Insiders":*

October 28, 1996

TO:

Robert Garrett
USPTO
2011 Crystal Drive Ste.401
Arlington, VA 22202

Dear Mr. Garrett:

Maura Regan invited me to be a speaker at a forthcoming Technical Lecture Series gathering at the USPTO. Then I was told I needed to submit this brief proposal to you. Hence, the following.

Clearly, the USPTO is in great need of proper information on cold fusion and new energy, how else to explain that numerous patent applications in the field appear to be rejected on spurious grounds, having little to do with the substantial evidence and commercial development that has occurred in the field? I have been to five of the six international cold fusion meetings, including the most recent one in Hokkaido, Japan (October 13-18, 1996) and can bring a different perspective to the field than your office appears to have gotten from journalistic accounts and biased histories. May I point out that I am an engineer with advanced degrees (see attached CV) and am also the author of *Fire from ice: Searching for the Truth Behind the Cold Fusion Furor* (John Wiley & Sons, 1991). That book was nominated for a Pulitzer Prize and was endorsed by Nobel laureate Julian Schwinger. **I note that not a single representative of the USPTO has been to any of the international conferences on cold fusion, whereas a representative from the European Patent Office attended the Fifth International Conference on Cold Fusion, prior to provisionally allowing of that patent in Europe.** I note also that cold fusion patent rejections curiously do not refer to the information in *Fire from Ice*.

I understand that a Technical Lecture at the USPTO can be up to 90 minutes. In that time I would present a brief overview of the history of the field, conferences that have been held, commercial developments that have occurred, and the conclusions of those who are serious workers — not those who did highly flawed experiments for a few months in 1989 (MIT, Caltech, Harwell laboratories), drew incorrect conclusions, and then abandoned the field. Part of may talk will be devoted to the proof that those so-called negative experiments in 1989, so often cited by the USPTO, were not null experiments at all (yet these are still being used to reject applicants)!

I will also broaden my focus and discuss matters that are not directly in the mainstream of cold fusion. One device that I and others have personally tested for "over unity" and have been satisfied that it is a net energy producer, is the Griggs Hydrosonic Pump. Another is the Correa Pulsed Abnormal Glow Discharge reactor. Both these devices produce more energy output than energy input. I will discuss them. Moreover, I will review scientific theories that have been proposed in the peer-reviewed scientific literature that could explain these devices. Their performance is NOT in violation of the conservation of energy—anymore than a fission-powered nuclear reactor is in violation. I will also discuss various magnetic motors than claim over-unity performance, one of which—the Kawai motor—has already been issued a US Patent.

In summary, I will present a perspective that your office is much in need of. Perhaps this information will help to break the current logjam of cold fusion patent applications and will offer a way out for the USPTO, before it is too late. I will offer suggestions how this might be done.

Thank you for your kind consideration of Ms. Regan's invitation for me to speak to the USPTO. I enclose a recent issue of our magazine, Issue #9, for your information.

Sincerely,
Eugene F. Mallove, Sc.D.
Infinite Energy Magazine
(NO RESPONSE to this letter has been received.)

New Energy Technologies

"EXHIBIT A": Sample U.S. Patent Office Response to a Cold Fusion Application

"Trial by Media," Abuse of Logic, Violation of Constitutional Rights.....

Editor's Note:

An aerospace engineer, who is a graduate of a major US technical university, received this most unwelcome response to his application for a patent on a novel electrolytic excess energy-producing device, i.e. a cold fusion invention. Many other American inventors have received this type of "boilerplate" response from the USPTO, which is in the business of summarily rejecting essentially all patents in the cold fusion area and thus depriving US citizens of their Constitutional rights. (The Patterson patent and the Ahern-MIT patent sneaked through because of unusual circumstances in the former case and clever cloaking language in the latter.)

The USPTO has routinely sent stacks of general media clips to rejected applicants, pointing out that cold fusion is "not accepted by the media and scientists in general," therefore no patent is warranted. They have also appended specious arguments of the kind revealed here.

This response (reproduced in part), written by Harvey E. Behrend, "Primary Examiner, Group 2200," was received in mid-1996. The profound illogic of the response, Behrend's reliance on negative media reports, and use of quotes from the anti-cold fusion camp are prominent features. Behrend is well-known among rejectees. We have annotated his PTO response with bolded typeface, to draw attention to particularly egregious passages.

The bottom line is this: we have pack-mentality PTO bureaucrats conducting appalling assaults on the rights of citizens. It is our opinion that they will not relent until serious and sophisticated legal and/or political action is taken against them.

In 1996 there was an informal move to have a technical information seminar (after ICCF6) given by Eugene Mallove at the US Patent Office. On request, *Infinite Energy* sent a letter (see p.47, this issue of *IE*) outlining the reasons for such a seminar. No response has come from the USPTO. After promising to do so, the Public Information Office there pointedly did not send generic photographs of USPTO activities which were to be used in this article. Your "friendly" U.S. government agency at work!

—Eugene Mallove

Partial text of response by USPTO examiner Harvey E. Behrend:

Applicants arguments are unpersuasive.

Upon reading applicants claims in light of the disclosure, it is apparent that applicants invention is a method of producing thermal energy in a cold fusion system.

The specification on pages 3 and 4 for example, indicates that applicants invention is a method and apparatus for potential commercial scale-up and use of "cold fusion" systems of the type set forth on pages 1-3 of the specification (see also page 4 of the 1/11/96 response).

Thus, in determining whether or not applicants disclosure is sufficient and enabling, it is necessary to determine whether or not such "cold fusion" systems actually are operative.

The examiner, in the 8/11/95 Office action, has presented evidence that such "cold fusion" systems actually are not operative and, that the alleged showings of excess heat produced in such cold fusion systems are not valid in view of experimental errors, etc.

It remains the examiner's position that there is no reputable evidence of record to support any allegations or claims that in such systems, the production of "excess heat" or of the generation of energy, due to nuclear and/or chemical reactions are valid and reproducible, nor that the invention as disclosed is capable of operating as indicated and capable of providing a useful output (including producing enough heat to be useful commercially).

[No "reputable evidence of record" for excess heat!? What planet are we on?—*EFM*]

The examiner does not agree that the documents submitted by applicant with the 1/11/96 response, provide irrefutable evidence of the operability of such cold fusion systems.

Initially, it is noted that even some of these documents submitted by applicant indicate that such cold fusion systems are nuclear reaction systems (see for example, the Report Summary EPRI TR-104195s, Boucher et al, and Bittner et al. Fleischmann and Pons have maintained since their initial public announcement in March of 1989 that nuclear reactions are the cause of the excess heat allegedly obtained from their cold fusion cells.

More importantly, even some of the documents submitted by applicant cast doubt on the alleged positive results reported in others of the documents submitted by applicant.

For example, McKubre et al in *J. of Electroanalytical Chem.*, on pages 55 and 65 state that no excess heat was observed in light water experiments, thus casting doubt on the validity of the alleged positive light water results in Noninski (submitted with the 1/11/96 response) and on the alleged positive results of Mills and Kneizys, and of Robert T. Bush referred to in applicants specification on pages 2, 3 and 13. **[Note that Behrend deliberately confuses control experiments using light water with palladium, with excess heat-producing reactions in the nickel-potassium carbonate light water system. He falsely plays one group against another.—*EFM*]**

McKubre et al also indicate that for excess heat to be produced, the minimum D/Pd loading ratio must be greater than 0.9 and even exceed unity (e.g. see pages 55, 64, 65) which, casts doubt on the results of Storms who allegedly obtained positive results with a D/Pd ratio of 0.82 (e.g. see pages 230, 237, 240, 241 of the Storms document submitted with the 1/11/96 response) and, on the results of Bittner et al who allegedly obtained positive results with a D/Pd ratio of only 0.14 - 0.80 (e.g see page 347 of the Bittner et al document submitted with the 1/11/96 response).

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The examiner in said section 2 of the 8/11/95 Office action had indicated that the general consensus by those skilled in the art is that the alleged positive cold fusion experimental results, were actually based on experimental errors. **[Who are "those skilled in the art" — DOE's Huizenga, Taubes, Close, the MIT Plasma Fusion Center?—*EFM*]**

In this respect, even the EPRI or McKubre et al documents (both EPRI-104195s and McKubre et al) submitted with the 1/11/96 response indicate that the positive results were not obtained in all cases, even when using identical structures and identical methods of operation.

It is considered elementary that identical structures operated in identical manner, must produce identical results. Such is even relied on in ones everyday life. **[*Does Behrend have even an elementary acquaintance with science and technology?* Has he heard of the difficulties in catalysis reactions, of the problems in producing uniform semiconductor materials? How does he define "identical structures"? Is one piece of palladium—cracked, alloyed, or otherwise— as good as any other of the same size and shape? He can't be serious! He appears to be using this as a rhetorical device—absurd though it is.—*EFM*]**

If instrumentation, etc., indicates that identical structures operated in identical manners do not produce identical results, it is clearly the instrumentation, etc., that is suspect. **[Sure, he knows what is suspect! The man who has never been to a cold fusion scientific meeting in his life, and who told this reviewer in a 1996 telephone discussion, before ICCF6, that he had no intention of going to one!—*EFM*]**

Accordingly, the logical conclusion when one does not get identical results and/or the results are not reproducible at will in these cold fusion experiments is that the alleged positive results are due to experimental errors, instrumentation errors, etc. **[Oh, now the ante is upped. We see the phrase introduced "not reproducible at will." So there is some reproducibility in cold fusion being admitted by Behrend, but it must be at will.—*EFM*]**

It is noted that even the McKubre et al document (submitted with the 1/11/96 response) indicates on page 59 that it is impossible to eliminate all errors in a given experiment.

Clearly, when an artisan or experimenter as relying on the experimental results of a particular experiment(s) to establish certain facts, it is incumbent upon the experimenter to show that the alleged experimental results are valid and not just the result of experimental errors and that the alleged experimental results do not fall within the limits of experimental errors). **[McKubre has done that in spades! See in this issue of *IE* Jed Rothwell's review of the EPRI/SRI final report.—*EFM*]**

This is especially so when the experiments in question are (as here) in a field wherein the scientific community in general considers the alleged positive experimental results to be erroneous. **[Who cares about the "scientific community in general"—we are talking about frontier science here. Think *Galileo*, man!—*EFM*]**

For a discussion of errors arising in cold fusion tests or experiments, note for example, the book, "Too Hot To Handle," by Frank Close. Pages 259-263 of this book set forth various errors that can occur, leading to the erroneous conclusion that excess power was produced in the cold fusion experiments. Page 261 of this book contains the telling statements:

"In addition to these experimental problems there were several examples where the numerical evaluation of the data and assessment of errors were incorrectly or badly done or, in some cases, not done at all....

The DOE panel commented that there had been a noticeable lack of attention to the statistical assessment of errors, and that in some cares, where heat was being claimed, a group's claim of excess heat is not supported with results of sufficient precision to allow such a conclusion. More usually it is not possible to assess precision from reported results because the result is reported from a single run and no error bars are provided for the measured parameters....

The DOE panel noted: "Conclusions in this area simply cannot be accepted without a thorough assessment of the measurement errors. In its visits and conversations the members of the panel were struck repeatedly by the absence of critical assessments of this kind.'" (Underlining added).

[So, Behrend in 1996 drags up the pathetic arguments of the biased 1989 DOE panel, and the flimsy knowledge of calorimetry evidenced in theoretical physicist Close's 1991 tract! Nothing has changed. We are still in 1989-91!—*EFM*]

The examiner does not agree with applicants arguments that the disclosure is sufficient and enabling.

Applicant does not appear to have specifically discussed each of the issues presented for example on pages 5 and 6 of the 8/11/95 Office action. It is again pointed out that the specification does not set forth an example of an operative embodiment wherein specific values for each of the parameters are recited for said example. The specification for example does not set forth the wire diameter for example 1 nor does it set forth the wall thickness of the anode tubes nor does it set forth the spacing(s) between the cathode wire 7 and the anode tubes 6 nor does it set forth the spacing between the turns of the cathode wire (e.g. see fig. 1).

It remains the examiner's position that an undue amount of experimentation would be required to produce an operative embodiment of applicants invention. The examiner has cited numerous documents showing that experimenters have obtained negative results using various types of cold fusion apparatuses, all based on the cold fusion concept set forth by F and P.

This issue of undue experimentation has been succinctly addressed by Douglas Morrison at the Fourth International Conference on Cold Fusion Technology, (ICCF-4) held Dec. 6-9, 1993 in Hawaii (reproduced in transactions of Fusion Technology, vol. 26, Dec. 1994), see page 54 which states:

"IX. WHEN A COLD FUSION WORKING DEVICE?

8 December 1993; the previous speaker, Dr. H. Fox, giving he said, a business man's point of view, declared he expected a working Cold Fusion device in 20 years.

November 1993. Dr. S. Pons said that by the year 2000 there should be a household power plant - 6 years.

1992. Dr. Fleischmann said a 10 to 20 kilowatt power plant should be operational in one year.

July 1989. The Desert News published an article by JoAnn Jacobsen-Wells who interviewed Dr. S. Pons. There is a photograph in color, of Dr. Pons beside an simple apparatus with two tubes, one for cold water in and one for hot water out. This working unit based on Cold Fusion was described as; 'It couldn't take care of the family's electrical needs, but it certainly could provide them with hot water year-round,' said Pons.

Later in the article it was written 'Simply put, in its current state, it could provide boiling water for a cup of tea.'

Time delay to this working model - Zero years.

Thus it appears that as time passers, the delay to realization of a working model increases.

X. CONCLUSION

No conclusions are presented - everyone can judge for themselves, However some questions can be asked:

Are Cold Fusion results consistent in claiming Cold Fusion effects in Deuterium but not in normal Hydrogen while other groups claim Cold Fusion effects with hydrogen?

Is the ratio of tritium to neutron production about unity as Fleischmann and Pons originally claimed [5] or is the ratio in the wide range 10^4 an 10^9 as most other workers claim?

Are transmutations, Black Holes, Biology [18] part of the normal world of Cold Fusion?

To explain the null experiments there is one theory—the conventional theory of Quantum Mechanics, but there are a wide variety of theories to explain positive Cold Fusion results - can they all be valid simultaneously - if not, which should be rejected?

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"When can we have a cup of tea?" (Underlining added).

[Here we have the travesty of the USPTO using the clownish mockery and faulty logic of CERN's perennial cold fusion critic and "pathological science expert" Douglas Morrison to defeat a US patent application.—*EFM*]

The present case is considered analogous to that in In re Chilowsky, 134 USPQ 515 wherein the Court held the disclosure to be insufficient. In the present case, the examiner has shown that various necessary parameters have not been provided and, the examiner has provided evidence that the artisan does not know the requisite parameters of an operative cold fusion system, nor how to make an operative cold fusion system.

Note in this respect, the Court's statement on page 519 of In re Chilowsky:

"Chilowsky could not start to describe his invention with the assumption that those skilled in the art knew in detail how to build his nuclear reactor. Since it was a major part of what he purported to have invented, it was incumbent on him, under section 112, to tell how to build it, under principles of patent law too elementary to require discussion."

Furthermore, it is noted that there has essentially been a continuing stream of publications showing that virtually none of the scientific community consider the alleged positive results of cold fusion experiments as being confirmed. While being cumulative to the references already cited in said section 2 of the 8/11/95 office action, a representative sampling of said subsequent publications is set forth below. In this respect, applicants attention is directed to Ewing et al, Albagli et al [**An outrageous insult! This "Albagli et al" paper is the paper with the grossly misrepresented "no excess heat" data from the MIT Plasma Fusion Center in 1989, which has been questioned on ground of both technical and mathematical procedure, as well as for scientific misconduct in data misreporting.—*EFM*]**, Bosch et al, Balke et al, Fleming et al, Henderson et al, NOVA, Huizenga (I), Huizenga (II), Huizenga (III), Huizenga (IV), and Rogers et al. These references provide further clear evidence that no excess heat is generated in such "cold fusion" systems nor is there any evidence of nuclear reactions taking place.

There have been some Japanese claims of positive cold fusion results, however, note in this respect, the comments by David Williams in the Hadfield article on page 10 of the 10/31/92 issue of *New Scientist*. David Williams (head of the department of chemistry of University College London} described the claims as "absolutely pie-in-the-sky." **[Continuing his blatant bias, Behrend, citing Williams' statement to a journalist, does not mention the technical articles published that call into question the negative conclusions of Williams' own work.—*EFM*]**

The article by Williams et al refers to some of the spurious effects which have led to the claims of the existence of cold fusion. Note that Williams et al found no evidence of nuclear fusion in a non-equilibrium or pulsed system (e.g. see pages 378, 330, 383).

Note that in addition to Williams et al, the examiner has cited other documents showing how experimental data, etc., can be misinterpreted as providing evidence of the operability of cold fusion systems.

In this respect, the television show on NOVA entitled, "Confusion in a Jar," indicated that in these cold fusion experiments, it is fairly easy to get quick results which could be "interpreted" as providing evidence of "cold fusion" but that in very carefully run experiments which were rechecked, etc., such as by using several different methods and/or detectors to attempt to detect the same presumed experimental results, the end result was negative. **[Behrend refers to this biased program of 1990, but does NOT reference the more recent (1994) television documentary *Too Close to the Sun*, by the BBC and CBC, which put cold fusion in a more positive light. Hmmm!—*EFM*]**

Note the analysis of calorimetry with electrolytic cells of the F and P type, set forth in Wilson et al.

In the same vein, note the negative comments in Morrison (III) regarding the claims by F and P of excess enthalpy in their cold fusion cells which were made to boil.

The Broad article in the 3/17/91 issue of the *New York Times* indicates some of the data relied on by F and P as showing evidence of fusion was faulty.

The article by Taubes on pages 1299-1304 of the 6/15/90 issue of *Science*, explains why the alleged detection of tritium at Texas A & M cannot be relied on as evidence of "cold fusion" actually taking place. **[Behrend shamelessly uses the scurrilous allegation by Close of fraud (by P&F) and he puts forth the equally false and odious Taubes allegation of fraud (tritium spiking) for the Bockris lab at Texas A&M.—*EFM*]**

The examiner has presented evidence that even having a high-concentration of deuterium in the cathode or hydrogen absorbing material, will not result in nuclear fusion taking place (see for example, applicants specification on page 12 lines 7+, as well as the McKubre et al document and the Storms document, submitted with the 1/11/96 response. If nuclear fusion-reactions do not take place, the indicated excess heat will not be produced. In this respect, Silvera et al found no evidence of "cold fusion" with a D/Pd ratio as high as 1.34 and, Myers et al obtained negative results even with a D/Pd ratio as high as 1.6.

These teachings of negative results even with high D/ Pd loading ratios is particularly significant to applicants invention, which, as indicated, requires a high D/Pd ratio.

The Dagani article in the 1/14/9l issue of C & EN states that the "cold fusion" claims are taken seriously by virtually none of the scientific community and that research at Utah's National Cold Fusion Institute (NCFI) as well as research elsewhere, have failed to establish the existence of cold fusion .

A more recent article by Dagani (in the 6/14/93 issue of *C&EN*) entitled "Latest Cold Fusion Results Fail to Win over Skeptics," states that "the vast majority of scientists... dismissed the evidence of nuclear fusion results inside a metal lattice as nonsense—a case study in pathological science." **[Behrend again exposes his ignorance of science by referring to this irrelevant comment by a journalist. Science does *not* advance by popularity contests. Many of the greatest discoveries have always provoked opposition from the small-minded.—*EFM*]**

Note particularly the excerpts from the book, "Too Hot To Handle" by Frank Close. This book refers to various errors in the work of F and P (e. g. see pages 161+), as well as by other experimenters. Page 153 for example, lists various artifacts that may be misinterpreted as neutrons.

Note that Jones et al were also doing work on cold fusion involving the incorporation of deuterium into a hydrogen absorbing lattice. While Jones initially reported positive cold fusion results (the production of neutrons), and thus could be considered as a proponent of cold fusion, it is interesting to note some more recent statements by Jones on the issue of nuclear reactions and excess heat in these cold fusion systems.

This apparent transformation of Jones from a "cold fusion believer" to "skeptic" is discussed by Dagani in the June 5, 1995 issue of *C & EN*.

In a 1992 article in *Surface and Coatings Technology*, Jones takes the position that the claims of excess heat, tritium and helium production due to nuclear reactions are "dubious to say the least" (note page 288) because there is no evi-

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dence of commensurate nuclear products. Note the reference to $E=mc^2$ on page 286.

In the Taylor et al article (co-authored by Jones), which was submitted to the Fourth International Conf. on Cold Fusion (held in Dec. 1993), it is stated in regard to the detection of neutrons from their cold fusion experiments, "The results do not provide compelling evidence of neutron production" (more particularly the abstract and pages 6, 7, 9, 10).

Jones et al (II) and Jones et al (III) in J. Phys. Chem, vol. 99, {1995) on pages 6966-6972 and, pages 6973-6979 respectively, set forth reasons why the alleged obtainment of excess heat in cold fusion systems, can not be relied on as valid .

Taubes, "Bad Science: The Short Life and Weird Times of Cold Fusion," 1993, is a good reference for showing the view point of the scientific majority towards cold fusion. After interviewing over 250 people in the field, Taubes concluded that "Cold Fusion... did not exist," and "As long as financial support could be found, the research would continue... In fact, the few researchers still working in the field would have little incentive to acknowledge negative results as valid, because such recognition would only cut off their funds." Note page 426.**[Time and again Behrend attempts to validate his action against the patent by references to those who allege fraudulent activity as a general symptom of the cold fusion research community.—*EFM.*]**

Another good reference presenting a compilation and analysis of cold fusion work subsequent to the 1989 announcement of the cold fusion claims of F and P. is the book, "Cold Fusion: The Scientific Fiasco of the Century," by Huizenga (I). Huizenga was co-chairman of the DOE/ERAB panel on cold fusion. Note particularly the "Epilogue on pages 237-287 which discusses some of the alleged positive results presented at the First, Second and Third Conferences on Cold Fusion. Jones (referred to above) refers to Huizenga's book as "factual and hard hitting... The continuing cold fusion saga is a fascinating one from a human point of view, and Huizenga tells it well... I recommend Huizenga's book to all." (see the back cover and, page 105 of Huizenga (I)). **[Behrend stoops to using a book review by one negativist of another negativist's book!—*EFM*]**

On pages 201+, (and more particularly, page 214) Huizenga (I) indicates cold fusion can qualify or be characterized as "pathological science," defined as "the science of things that aren't so" (see also Huizenga (II), Huizenga (IV), Morrison (II) and Rousseau in this respect).

On page 206, Huizenga (I) states that some of the similarities between cold fusion and other unsubstantiated concepts, are (1) lack of control experiments, (2) statistical uncertainties, (3) irreproducibility and (4) the public description as a "simple experiment." Note particularly pages 125, 222, 223, of Huizenga (1) which refer to the lack of reproducibility of the alleged "positive cold fusion results."

Clearly if something cannot be reproduced at will, there is also, then, no enabling disclosure which would enable one of ordinary skill in the art, to make and use it, as required by the statute (35 USC 112).

Accordingly, the references cited above and in said section 2 of the 8/1/95 Office action are considered as providing irrefutable evidence of the inoperability of a "cold fusion" system of the type set forth by F and P, as well as that of applicant. Applicant has not shown this evidence to be in error.

Note that these references cited by the examiner show how experimental data, etc., can be misinterpreted as providing evidence of the operability of cold fusion systems.

Accordingly, all of the issues set forth in said section 2 of the 8/11/95 Office action are still pertinent in determining the patentability of applicants claims.

Applicants attention is directed to the Board decision in Ex part Dash, 27 USPQ 2d 1481, wherein it was held that the examiner did not err in rejecting claims for "cold fusion" of nuclear energy for lack of enablement under 35 USC 112 and as inoperative and lacking utility under 35 USC 101, since evidence demonstrating that neither excess heat nor traditional nuclear by products of fusion reaction have been detected by careful.....**[gap in copy]**

As pointed out in section 2 above, applicants invention involves a concept or expedient which has become known in the art as "cold fusion." All of the embodiments of applicants invention as disclosed in the specification, are directed to producing heat energy by obtaining a high concentration of hydrogen isotopes in a metal host lattice (a concept which has become known in the art as "cold fusion"). No other utility is set forth or otherwise disclosed. Note that claims must be read in light of the specification. Accordingly, the documents cited by the examiner in regard to the inoperability and lack of utility of such "cold fusion" systems, are clearly germane to the patentability of applicants claims.

Applicants attention is directed to page 89 of Huizenga (I). Said page 89 reproduces the conclusion of the final report of the DOE/ERAB panel on cold fusion. Conclusion (1) states that there is no "convincing evidence that useful sources of energy will result from the phenomena attributed to cold fusion."

Applicants attention is directed to the case law cited on page 10 of the 8/11/95 Office action, in support of the examiner's "position" that were [**where?**] the utility of the claimed invention is based upon allegations that border on the incredible or allegations that would not be readily accepted by a substantial portion of the scientific community, sufficient substantiating evidence of operability must be submitted by applicant.

The above "position" which is well supported by case law, is considered as clearly being applicable against applicants claimed invention, particularly in view of the comments in the articles cited above and in the 8/11/95 Office action, concerning the inoperability (and hence lack of utility) of such "cold fusion" systems.

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 C.F.R. § 1.136(a).

A SHORTENED STATUTORY PERIOD FOR RESPONSE TO THIS FINAL ACTION IS SET TO EXPIRE THREE MONTHS FROM THE DATE OF THIS ACTION. IN THE EVENT A FIRST RESPONSE IS FILED wITHIN TWO MONTHS OF THE MAILING DATE OF THIS FINAL ACTION AND THE ADVISORY ACTION IS NOT MAILED UNTIL AFTER THE END OF THE THREE-MONTH SHORTENED STATUTORY PERIOD, THEN THE SHORTENED STATUTORY PERIOD WILL EXPIRE ON THE DATE THE ADVISORY ACTION IS MAILED, AND ANY EXTENSION FEE PURSUANT TO 37 C.F.R. S 1.136(a) WILL BE CALCULATED FROM THE MAILING DATE OF THE ADVISORY ACTION. IN NO EVENT WILL THE STATUTORY PERIOD FOR RESPONSE EXPIRE LATER THAN SIX MONTHS FROM THE DATE OF THIS FINAL ACTION.

7. Any inquiry concerning this communication should be directed to Mr. Behrend at telephone number (703) 305-1831.

Behrend/gj-15
4-18-96

Harvey E. Behrend
Primary Examiner
Group 2200

by Dr. Eugene F. Mallove
***Infinite Energy* Editor-in-Chief**
and author of *Fire From Ice*
Generate lots of excess heat (and new-thinking!) in your scientific, engineering, business, civic, or religious organization. Call:
Cold Fusion Technology, Inc.
Phone: 603-228-4516
Fax: 603-224-5975

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ICCF-7 News
Vancouver, Canada April 19-24, 1998

Letter received from the ICCF-7 organizing committee:

February 7, 1997

Greetings,

Welcome to beautiful Vancouver, Canada's gateway city to the Pacific and the conference site for the 7th International Conference on Cold Fusion (ICCF-7).

I would like to invite you, your colleagues, and your spouse or partner to attend the conference on April 19-24, 1998. ICCF-7 will take place in Vancouver's waterfront Convention & Trade Centre which is pictured in the foreground on the cover of the enclosed brochure. Vancouver is a safe, clean city where the snowcapped Canadian Rocky Mountains meet the clear blue Pacific Ocean.

The exciting field of low energy induced nuclear reactions in solids has continued to mature, and many new, compelling scientific findings are becoming known. The ICCF conference series provides a unique forum for direct interaction with top scientists from around the world. The diversity and quality of on-going research and its commercial implications make ICCF-7 an important event that should not be missed.

Enclosed is a three page ICCF-7 Preview, a Vancouver information brochure, and a questionnaire form. Please return your completed questionnaire by March 1st, 1997. Wherever possible, we will incorporate your input into the Vancouver program. The ICCF conferences are organized solely to benefit you, the participant, so be sure to give us feedback on your preferences.

With your input and support, ICCF-7 will truly be *"The Best Ever!"*

Sincerely, Fred Jaeger
Organizing Host for ICCF-7

c/o ENECO, 391-B Chipeta Way, Salt Lake City, UT 84108; PH:(801) 583-2000; Fax: (801) 583-6245; jaeger@ENECO-USA.com

Excerpts from the ICCF-7 mailing:

SCIENTIFIC PROGRAM

Selection rules and evaluation criteria for papers will be sent to all potential presenters beginning with the June '97 call for abstracts. The final announcement of oral and poster categories will be sent by December 15, 1997.

The LOC (Local Organizing Committee) will adopt a standard set of published guidelines for objective evaluation of all papers. A different topic is planned for each day at ICCF-7. It is proposed that an invited presentation with summary review or global implications for the entire field begin each day's topic. Following the opening session, five 20-minute oral presentations are proposed that meet specific criteria for the best individual work based on rigor, quality, uniqueness, innovation, and clarity of English language presentation. Afternoons will be entirely devoted to enhanced poster sessions, which include a 3-5 minute oral preview and summary.

Something new? ... Have all ICCF-7 participants drop a name in a box at Wednesday eve's banquet to vote for the ten posters with the highest interest. Each of the "Top Ten" poster presenters selected will conduct a 15 minute expanded oral presentation to the full audience Thursday afternoon.

Something different? ... Official concluding ceremonies will take place at a Friday morning brunch. Events could include a mix of formally prepared scientific conclusions and an informal discussion session. The informal session would permit and encourage a wide cross-section of audience members to voluntarily present their own 3-5 minute impromptu talk about "What ICCF-7 meant to me"; or "What was the most interesting presentation to me and why"; or "Where I think we should go from here and why"; etc.

Something late? ... Evening educational workshops that present recommended experimental techniques to properly measure heat, helium, and low-level nuclear events are proposed.

Program Summary: 4 Invited Presentations, 20 Oral Presentations, 10 extended oral presentations of posters, 150-180 poster presentations, three evening workshops, and a half-day closing ceremony.

Other information:

The ICCF-7 venue is a government owned Trade & Convention Center on the waterfront in the heart of downtown. Ballrooms have been rented that hold between 225-450 persons in classroom seating, with expansion capability to 1,100 persons. An estimated $450 USD per person conference fee would include the Sunday eve reception, all sessions and publications, Wednesday eve entertainment & banquet, four lunches, mid-morning and afternoon refreshments, and Friday morning brunch. Some 415 hotel rooms in five Vancouver hotels have been blocked at special conference rates: Pan Pacific, Waterfront, Hyatt, Renaissance, and Day's Inn.

With maturation of the field, ICCF-7 seeks to attract a more diverse audience: additional scientists, research institutes, students, national funding agencies, commercial interests, journalists, and spouses.

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CALENDAR

1st Low-Energy Transmutation Meeting
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-October 1, 1995
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16th Symposium on Fusion Engineering (SOFE '95), *with cold fusion component!*
October 1-5, 1995
Champaign, Illinois

Third Russian Conference on Cold Fusion and Nuclear Transmutation
October 1—8, 1995
Sochi, Russia

Power-Gen '95
(CETI cell demo)
Anaheim, California
December 5-7, 1995

New Ideas in Natural Sciences
June 17-22
St. Petersburg, Russia

1996 International World Energy System Conference
June 19-21, 1996
Toronto, Canada

2nd Low-Energy Transmutation Meeting
College Station, Texas
Sept.13-14, 1996

ICCF6—Sixth International Conference on Cold Fusion
October 13-18, 1996
Hokkaido, Japan

Building Energy—Insuring a Sustainable Future
March 12-15, 1996
(Sponsor: Northeast Sustainable Energy Association)
Radisson Hotel and Conf. Center
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INTERNATIONAL SYMPOSIUM ON NEW ENERGY
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The author, Frank Znidarsic, has a B.S. in Electrical Engineering from the University of Pittsburgh, has an Associate in Science from Saint Francis College, and is a registered professional engineer in the state of Pennsylvania.

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TAPE#1

Dr. Eugene F. Mallove
(Cold Fusion Technology, Concord, NH)
"Cold Fusion and New Energy Technology - An Overview"

Dr. Peter Graneau
(Northeastern University Center for Electromagnetic Research) "Anomalous Forces in Water Plasma Explosions"

TAPE#2

Buford ("Ray") Conley
(MIT, graduate student, Dept. of Aero/Astro Eng.)
"Light Water Excess Heat Experiments"

Fred Jaeger
(ENECO, Salt Lake City)
"Patents and Commercialization"

Professor Peter L. Hagelstein
(MIT Dept. of Electrical Engineering and Computer Science) "Cold Fusion: What We Know and What We Don't Know"

TAPE#3

Professor Peter Hagelstein
(CONTINUED from TAPE #2)
"Cold Fusion: What We Know and What We Don't Know"

Professor Keith Johnson
(MIT Dept. of Materials Science and Engineering)
"Progress in the Theory of Excess Heat" *and Excess Heat*- The Movie, now being made by Hollywood!

James L. Griggs
(Hydro Dynamics, Inc., Rome, Georgia, USA)
"The Hydrosonic Pump: Excess Power and Other Effects"

TAPE#4

Bertil Werjefelt
(PolyTech(USA), Hawaii)
"Energy from Magnetic Materials and Magnetic Fields"

Dr. Eugene F. Mallove
(Cold Fusion Technology, Concord, NH)
Concluding Remarks

The tapes include the speakers' presentations as well as question and answer sessions. There is footage of the Hydrosonic Pump under test as well as close-up footage of rotor surface melting effects. Bertil Werjefelt shows footage of experiments in his own laboratory. There are scenes of Japanese researchers from Sumitomo, Hitachi, and other companies and universities now involved in their claimed extraction of energy from magnetic materials. These efforts are now said by these researchers to be proceeding toward commercialization. Actual experiments are seen in progress. The tapes are VHS cassettes in NTSC format and range from 120 to 127 minutes each.

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4-AA	TOM VALONE.....	FREE ENERGY & PROPULSION
5-AA	JAMES GRIGGS.....	THE HYDROSONIC PUMP
6-AA	EUGENE MALLOVE.....	COLD FUSION & NEW ENERGY
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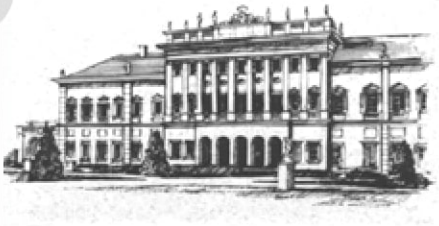

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In the Black?

Informed sources have told *IE* that BlackLight Power Corp. of Malvern, Pennsylvania (formerly Hydro Catalysis Power Corp.), will make one or more major announcements within the next six months. It is anticipated that this will include additional scientific evidence in support of the "hydrino" (shrunken hydrogen atom) model of Dr. Randell Mills, as well as the announcement of prototype gas-phase heating and/or electricity-generating units. "BlackLight" refers to ultraviolet emissions purportedly measured from catalytically shrunk atoms. Commercial backers supporting BlackLight Power are thought to be readying some type of product introduction. *IE* has been informed that BlackLight has abandoned its former liquid-phase electrolysis work, because of its perceived inadequate power density for commercial applications. The fuel now being used is hydrogen gas in contact with special catalytic (presumably metal) substrates.

CETI and Environmental Corporation Join Forces

Following coverage in *Infinite Energy* #10 of the latest developments with CETI's RIFEX™ kits and radioactive remediation patent (approved by the US PTO and awaiting number assignment), we received news of further developments in the form of the following press release:

****

Clean Energy Technologies, Inc.

Press Release
Contact: Douglas Collins
(702)825-1727

February 20, 1997

CETI + DRI = MOU ....
A Formula For Success
Nuclear Scientists Reach Agreement on New Energy Technology

Clean Energy Technologies, Inc. (CETI™) has signed a Memorandum of Understanding (MOU) with the Desert Research Institute (DRI) to jointly pursue research and development for advanced energy technologies and secure, clean energy production.

CETI™ has developed some patented technology for energy production with the Patterson Power Cell™ which has been featured on ABC's Nightline and was ABC's top science story for 1996. Dr. James Patterson of Sarasota, Florida is one of the USA's most respected scientists with over 150 U.S. patents held in a variety of technical disciplines.

The secret to the Patterson Power Cell™ is in the CETISpheres™, uniform microspheres with special coatings that appear to contribute to the remarkable energy production of the power cell. The high energy production has captured the interest of serval major corporations as well as several major universities.

As *The Wall Street Journal* reported, "The Patterson cell can be turned on and off seemingly at will. Several working devices have been made available to two teams."

"This is the first time that we have a system that seems to work every time," says a nuclear chemist who consults to utilities. The cell's reliability, which would allow scientists to manipulate it, "gives us our first chance to see if this [phenomenon] involves a nuclear reaction," he explains.

And it is not the same old cold fusion story...The US Patent and Trademark Office, which has maintained that cold fusion is impossible and unpatentable, have issued Dr. James Patterson several patents on this device.

In addition to the clean energy production, the Patterson Power Cell™ appears to have inherent potential for radioactive waste remediation. Desert Research Institute will be a key partner in exploring this tremendous opportunity by the demonstration and verification of patented CETI™ technology.

Created in 1959 by an act of the Nevada Legislature, the Desert Research Institute was established as a unit of the University of Nevada. DRI pursues a full-time program of basic and applied environmental research on a local, national, and international scale. DRI's 400+ scientists, technicians, and support staff conduct some 100 research projects annually.

Over its 35 year history, the Desert Research Institute has grown to be one of the world's largest multidisciplinary environmental research organizations. With five major research centers, Water Resources, Atmospheric Sciences, Energy and Environmental Engineering, Biological Sciences, and Quaternary Sciences, DRI has conducted research in every state and on every continent of the world.

"We are pleased to be in partnership with such a distinguished research partner as the Desert Research Institute," said James Reding, president and CEO of Clean Energy Technologies, Inc.

Clean Energy Technologies, Inc.(R)
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Corporate Offices: 2074 20th Street, Sarasota, Florida 34234 * (941)-951-2384 * Fax (941) 365-0487
Internet Home Page: www.cleanenergy.com/ceti

Infinite Energy believes that this announcement means—at the very least—that DRI scientists have checked out the radioactive waste remediation potential of CETI's new processes and find them to be verifiable and useful.

ICCF6
Proceedings Now Available

The two volumes of the ICCF-6 Proceedings (6th International Conference on Cold Fusion, Japan, October 1996) are available to the public at 10,000 yen per volume. You will need the two volumes so it is 20,000 yen. This is about $167.00 at 120 yen to-the-dollar.

The proceedings are hefty: The package weight is 2.5 kilograms for two volumes. The volumes are of unequal weights: approx.1.5 Kg. for Vol. 1 and 1.0 Kg for volume 2 if you take vol 2 to be 1/3 lighter than vol.1 (v.1@ 417 pgs, v.2@ 212 pgs) You need this to figure the additional cost of the mode of delivery to *add* to the volume cost.

This information was received by Fax by our US colleague, Mr. Akira Kawasaki:

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Regards, Conference Secretariat

New Energy Times Archive

Fast Bubbles

Colleague Scott Little of EarthTech International, Austin, Texas, sent us this notice of an upcoming article:

PHYSICS NEWS UPDATE
The American Institute of Physics
Bulletin of Physics News
Number 307 February 12, 1997
by Phillip F. Schewe and Ben Stein

SONOLUMINESCENCE BUBBLES COLLAPSE AT MORE THAN FOUR TIMES THE SPEED OF SOUND, new experiments have shown. Sonoluminescence is the still-mysterious process in which sound waves aimed at a water tank cause bubbles to collapse and generate ultrashort light flashes which represent a trillionfold concentration of the original sound energy. UCLA researchers (Seth Putterman, 310-825-2269) determine the speed of bubble collapse by measuring the amount of laser light scattered from a bubble during different points of its implosion. The amount of scattered light is proportional to the square of the bubble radius. Previous experiments could only establish that the bubble collapsed faster than the speed of sound; using ultrashort (100-fsec) laser pulses has now enabled the researchers to ascertain that the bubble collapses at a speed greater than Mach 4 (more than 1 km/s for this tiny bubble). This confirms a major prediction of the leading explanation for sonoluminescence known as the shock-wave model but does not rule out competing explanations because this and other experiments to date can only probe the outer surface of the bubble, not what is happening inside. In addition, the UCLA team determined that the bubble accelerates by at least 10^{11} g when the bubble stops compressing and starts expanding; amazingly, the bubble remains intact during this massive acceleration. (K.R. Weninger et al., upcoming article in *Physical Review Lett.*)

Ad Refused —Sight Unseen

We have heard of ads being rejected for "inappropriate content," but what about an ad being rejected by a supposedly scientific magazine without the ad even being seen? This happened to *Infinite Energy* recently, when the excellent publication, *Science News*, rejected our magazine's request to place a 1/6th-page ad (quite expensive!) in the March 1, 1997 issue. No other conclusion can be drawn other than we were discriminated against because of our subject: cold fusion and new energy.

A letter requesting an explanation was immediately faxed to *Science News*. It has received no reply. Phone messages were not returned. This was the letter sent:

To: *Science News*
Julie Ann Miller, Editor
Thomas Peter Bennett, Publisher
Cait Anthony, Books/Advertising

Dear *Science News* friends:

I have been waiting for a return telephone call regarding why our magazine's request to place a 1/6th page ad in your March 1, 1997 issue was apparently refused. Mr. Peter Griffin of Lewis & Edge Associates, your representative, told me that this was a very unusual event. May I please have the favor of an explanation for this circumstance?

If there is simply a misunderstanding, then we look forward to advertising in *Science News* in your March 1, 1997 issue. On the other hand, if there is some reason that you can give for refusing our ad, our technical readers in laboratories and corporations in over 24 countries —as well as concerned average citizens— would certainly like to know what that explanation might be.

For your information, I am faxing you a copy of the page in *Chemical & Engineering News*, June 3, 1996, which carried an ad larger than the one we want to place in *Science News*. I do hope to hear from you soon.

Sincerely,
Eugene F. Mallove, Sc.D.
Editor-in-Chief & Publisher
Infinite Energy Magazine

****

Infinite Energy readers should know that we immediately placed an ad in a journal that could ultimately have far greater impact—*if* it works! It is in a publication aimed at TV and radio talk-show hosts. We'll let you know what happens. Still, it is very sad and outrageous that such a narrow-minded (bigoted?) response was received by a magazine that should know better. **Shame on *Science News*!**

Minato Patent

Infinite Energy, Issue #9, p.8-9 profiled news from Japan of yet another potentially O/U magnetic motor. Reader Jim Day, using the USPTRO data base (via the http://patents.cnidr.org/ Web page), tracked down the patent of inventor Kohei Minato.

United States Patent 4,751,486 Minato
June 14, 1988

Magnetic Rotation Apparatus

Inventors: Minato; Kohei (Dear City Akasaka Hitotsugikan No. 303, 2-3, Akasaka 4-chome, Minato-Ku, Tokyo 105, JP). Appl. No.: 042,432 Filed: Apr. 24, 1987PCT Filed: Jan. 22, 1987 PCT No: PCT/JP87/00039 371; Date: Apr. 24, 1987 102(e) Date: Apr. 24, 1987 PCT Pub. No.: WO87/04576 PCT Pub. Date: Jul. 30, 1987 Foreign Application Priority DataJan. 24, 1986 [JP]61-13061 Intl. Cl.:H01F 7/14 U.S. Cl.:335/272; 310/156 Current U.S. Class:335/272 Field of Search:335/253, 254, 272; 310/77, 156

Abstract

The magnetic rotation apparatus of the present invention has first and second rotors rotatably supported and juxtaposed. The first and second rotors are connected so as to be rotatable in opposite directions in a cooperating manner. A number of permanent magnets are arranged on a circumferential portion of the first rotor at regular intervals, and just as many permanent magnets are arranged on a circumferential portion of the second rotor at regular intervals. Each permanent magnet has one magnetic polarity located radially outward from the rotors, and has the other magnetic polarity located radially inward toward the rotors. The polarity of each permanent magnet, which is located radially outward from the rotors, is identical. When the first and second rotors are rotated in a cooperating manner, the phase of rotation of the permanent magnets of one rotor is slightly advanced from that of the permanent magnets of the other rotor. One of the permanent magnets of one rotor is replaced with the electromagnet. The radially outward polarity of the electromagnet can be changed by reversing the direction in which a current is supplied to the electromagnet.

6 Claims, 5 Drawing Figures

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Today's typical commercial power plant generates high temperature heat, which in turn produces high pressure steam. A steam turbine then converts some proportion of that heat into electricity. But as the temperature falls, the usually applicable ideal (theoretical) engine cycle, named for Sadi Carnot, the Frenchman who is credited with the discovery, makes it much more difficult to convert the heat produced into electricity.

The formula that reflects the problem can be stated

Continued on page 79

New Energy Times Archive

EVERYDAY KILLERS a series in *The New York Times*

***Commentary* by Jed Rothwell**

It is good to be reminded why cold fusion is so important. *The New York Times* recently published a two-part series on Third World health problems titled "Everyday Killers," by Nicholas D. Kristof:

Malaria Makes a Comeback, And is More Deadly Than Ever, January 8, 1997
For Third World, Water Is Still Deadly Drink, January 9, 1997

The first article reports that malaria kills between 1 and 3 million people every year. The numbers are unclear. Most of these deaths could be prevented by sleeping under mosquito nets. A $5 net impregnated with insecticide can cover several people. The article describes the horrifying predicament faced by many parents:

> Mrs. Nhem Yen, a Cambodian villager, has one small mosquito net – and that is the source of her anguish. A 40-year-old woman with thick hair brushed to the side around a high forehead, Mrs. Nhem Yen has five children and two grandchildren in her little hut. Every evening she must figure out which children sleep under the net, and which sleep outside the net and risk death.
>
> "It's very hard to choose," Mrs. Nhem Yen said softly, her children clustered around her. "But we have no money to buy another mosquito net. We have no choice."

The *Times* says the World Health Organization recently declared that the mosquito is "public health enemy No. 1."

Cold fusion cannot directly contribute to controlling malaria. It might make people richer so they have more money to buy mosquito nets, screens, and medicine. But it can help directly with the other great public health crisis: unsanitary drinking water. This causes widespread illness and death. It kills roughly 3.5 million people per year, mostly children. This is approximately 68,000 victims per week, more than the total number of U.S. soldiers killed in the Vietnam war. The biggest threat from water pollution is not industrial waste, it is disease from human waste. The article concludes: "All in all, human wastes may be more menacing than nuclear wastes, for feces kill far more people than radioactive substances."

Almost all of water borne diseases could be eliminated by boiling the water used for cooking and drinking and by cooking foods more thoroughly. Better hygiene would also eliminate them, but boiling will work. Unfortunately, for a family of four in India, the kerosene required to boil the water costs about $4 per month. Many poor families earn less than $20 per month, so this is much more than they can afford.

Cold fusion might ameliorate this problem by giving people cheap energy to boil drinking water and cook food. If a high-temperature cold fusion device could be made as cheaply as a kerosene burner or electric stove, it could save millions of lives every year. Boiling water is a work-around. It is not as effective as proper sanitation. As the article explains, "billions of people in the third world don't have access even to a decent pit latrine." In other words, in many parts of the world shovels would do more good than either kerosene or cold fusion. Latrines or septic systems would be a great benefit on land with good drainage and percolation. Concrete lined cesspools can be effective. The next step — to water pipes, sewers, and waste treatment plants — costs far more than poor third world communities can afford.

The *Times* listed some statistics for the most common water borne diseases:

	Deaths per Year
Diarrhea	3,100,000
Schistosmiasis	200,000
Trypanosomiasis	130,000
Intestinal Helminth Infection	100,000
Total:	3,530,000

Sources: World Health Organization, American Medical Association, and the *Encyclopedia of Medicine*.

Whether you use kerosene or cold fusion, boiling drinking water is a stopgap solution to the problem. It depends on the initiative of individuals. A mother might conscientiously boil drinking water, but when she is not around the children may not bother. It is far better and more efficient to secure a source of pure water for the whole neighborhood or village, and to drain off sewage. On the other hand, the ad-hoc one-at-a-time method of boiling water is good because it allows individuals to solve the problem on their own, immediately, without depending on community action. It fits in well with the "micro-loan" model third world assistance programs, which were pioneered by organizations like Oxfam. Until the 1980s, most foreign aid dollars were spent on large, centralized projects like dams and factories. The money was often channeled through local government agencies, which often wasted it because of corruption and inefficiency. A micro-loan program is a bank that loans small sums of money at low interest directly to individuals and families, sums small as $10 to $100 in many cases. The only other sources of credit for most of these people are usurers and pawnshops. People use the loans for their farms and businesses, for things like chicken feed or a sewing machine for a tailoring business. The credit rating of these third world borrowers is excellent. They are extremely anxious to pay the debts on time, because their lives depend on maintaining a line of credit, and because they often have an old-fashioned sense of honor. This is illustrated in the first *Times* article, which describes why one family does flee from an area where malaria is endemic:

> It is not just that her husband has a job there cutting wood and thus the family has food to eat, or even that the family's entire savings – $4 – were spent when they moved here in April. Rather, the problem is that the family puts honor above all else.
>
> One of the couple's four sons, Rathna, a year-old who was scampering naked around the hut, nearly died of malaria a couple months ago. Mrs. Chim Savan managed to save his life, but only by borrowing $22 so that he could spend a week in a hospital for a blood transfusion and other treatment.
>
> So now the parents have saved Rathna, but they feel they are honor-bound to stay in the village until they can repay the $22 to the woodlot owner, who lent them the money. The risk is that in the meantime their other children will die.
>
> "If I weren't in debt I would leave," Mrs. Chim Savan said. "But when we were in trouble, the owner helped us, so now we have to help him. Because he was good to us.

The *Times* praised the micro-loan movement in an editorial on February 16, 1997, "Micro-Loans for the Very Poor." It reported that eight million people are now getting them, about half in Bangladesh, and in 42 other countries. About $1.2 billion is lent, which is 2 percent of world's third world development budget. The Grameen Bank pioneered micro-loans. It lends to small groups of people rather than individuals. The Times reports that loan recipients "pledge to boil their water, keep their families small and carry out other good health practices. People who repay small loans on time can take bigger ones."

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The Hydrosonic Pump Might Help

The Griggs Hydrosonic Pump™ (see *IE#*5&6, pp.25-27) is another interesting low-tech solution to this problem. This device appears to produce excess energy, but not enough so far to be economically significant. That is irrelevant to this application, in any case. The Griggs machine is now being sold primarily as a device to boil and purify waste water in U.S. factories. It is better than a conventional boiler because it does not clog up as easily. The temperature of the machine as a whole is no hotter than the fluid inside it. With a conventional electric heater or external flame, some parts of the boiler housing get very hot. Scale and debris from the boiled water builds up at these spots. In the third world or in a rural U.S. location the Griggs machine can be driven by a windmill or waterwheel.

A Vicious Circle

People who are sick all of the time do not have the energy to work, to dig latrines, or to improve their neighborhood. They spend what little money they have on expensive, stopgap fixes like medicine and kerosene to boil water. The article describes this vicious circle:

> "We have no blanket, no medicine and not enough food to eat," said Soy Phal, 31, a Cambodian who is herself feverish with malaria and whose husband died of the disease three years ago. "How can I afford a mosquito net? I spend my life being sick, so I have no time to earn money to get a mosquito net."

Ignorance Is Often the Real Problem

Ignorance causes much of the suffering. Children have no idea that filth causes disease. The *Times* article opens with a scene familiar to anyone who has traveled in the third world, although it is unthinkable to Americans and Europeans:

> Children like the Bhagwani boys scamper about barefoot on the narrow muddy paths that wind through the labyrinth of a slum here, squatting and relieving themselves as the need arises, as casual about the filth as the bedraggled rats that nose about in the raw sewage trickling beside the paths.

Adults realize that this causes disease, but they are not convinced of the fact enough to discipline their children, or to dig proper latrines. In some urban slums there is not enough room, but that is not a problem in rural villages, yet in many of them water-born diseases are endemic. Many crowded Japanese towns and villages today have no running water or sewer systems. (At least, they still do not in rural Yamaguchi, where I often spend my summer vacation.) Houses are equipped with concrete cesspools only, which were emptied by hand until the 1950s. Yet there has been no water-born disease in these villages in modern times.

For those who have forgotten why science is so important, the article illustrates the curse of superstition and ignorance:

> . . . because of his lack of education, the money is wasted.
>
> The most recent child in the family to fall seriously ill was Tatu, Mr. Simba's 18-month old daughter, who in September began to come down with severe diarrhea and fever. Mr. Simba took her to the local traditional healer and without question handed over the huge sum of $20, along with a chicken, and $8 worth of cloth used for the magic.
>
> The healer put Tatu under the bed and had her mother squat on top of it and urinate, drenching the child. Then the healer burned elephant dung and had the child breathe the Fumes.
>
> "Usually it helps," Mr. Simba said dejectedly. But not this time, for Tatu died. Mr. Samba aches at the loss of a sixth child, yet he continues to offer his family the same water.

There are times when many small machines can replace large, centrally located ones, and do a better job. Cold fusion looks like it may become an ideal example.

Cold Fusion No Panacea, but Better than Alternatives

No technology is a panacea for social problems. But, if it is used intelligently, cold fusion could help alleviate third-world poverty. Anything which directly raises the standard of living of the poorest people will help. People need breathing room. They need respite, so they can get back on their feet and work. Whether cold fusion is used to help poor people or not will depend upon policies set by the politicians, industrialist leaders, and approved by the voters in democratic nations.

Technology does not help people automatically, just by existing. We already have technology that might have lifted every person on earth out of abject poverty decades ago, at no cost to the developed nations or to wealthy people in the third world. Mosquito netting would eliminate almost all cases of malaria, and shovels could eliminate most serious problems with the water supply and sanitation. It would cost us nothing to supply poor people with nets and shovels. Indeed, you could make a reasonable profit selling these things. You have to give away some of the nets. You have to lend many of your customers small sums of money (micro-loans) to purchase the nets. But, by ensuring their long-term good health, you would reap a profit millions of times greater than cost of the nets and shovels over the productive lifetime of the people whose lives you save. The problem is that the leaders who have the means to solve these problems, and set up hardware stores in third-world slums, do not want to bother. In the short term, it is not very profitable. The poor people have not taken the initiative to dig their own latrines with whatever tools they can scrape together at hand. There is plenty of blame to go around, just as there are many potential solutions.

We hope that cold fusion reactors can be made small, reliable, and cheaply, for use in a single house. Small cold fusion power and heating reactors would be much better for third world customers than alternatives like large-scale fission and plasma fusion reactors (*Ed.—which do not and probably never will exist*). Cold fusion reactors are potentially cheaper per watt of energy, because they are simpler, they use cheaper material, and they do not produce massive, ionizing radiation, so they do not require massive shielding. They will not need a centralized distribution network of power lines and wires, which does not exist in many third world countries. The biggest advantage would be that individual people will decide for themselves to buy the reactor. People will not have to wait for corrupt governments or power companies to serve their needs. They will be able to solve their own problems, just as they do today with micro-loans. We hope that someday, small cold fusion reactors will be as cheap as a kerosene stove is today. Or if they cannot be made that cheaply, we hope they will cost about as much as a television or a motorcycle. These items are extremely popular and useful to people in the third world. Even in Japan, farmers routinely carry eggs, fish and crates of oranges on the back of motorcycles.

Once people raise their standard of living, they usually pay more taxes and begin asserting their rights more vociferously. Governments and corporations then pay more attention to their needs. Perhaps

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people can begin by boiling drinking water, so they stay healthy, work, and go to school. Then they can make a little more money and eventually be in a position to demand that the local utility companies build proper sewers, which are a much better long-term solution to the problem.

Cold fusion is a good example of what has been called "small technology." A great deal has been written about "small" or "appropriate technology." versus "big technology." This was popularized in a book by E. F. Schumacher, *Small is Beautiful* (1973), and by Amory Lovins, "Energy Strategy: The Road Not Taken," *Foreign Affairs* magazine (October 1976). Much of this strikes me as misguided or unworkable. Small technology in the form of automobile engines and wood-burning stoves are major sources of pollution and deforestation. The problems with Schumacher's book were summed up in a masterful essay by Samuel C. Florman, "Small is Dubious," in his book *Blaming Technology* (St. Martin's Press, 1981). The distinction between big and small technology is somewhat artificial. Automobiles, motorcycles and bicycles are small decentralized machines in one sense, but they require good roads, which can be thought of as massive machines, and which require strong central government coordination to build and maintain. Small, personal computers require the largest, most expensive, multibillion-dollar microprocessor and memory chip fabrication plants ever built. Personal computers have concentrated monopolistic power in the hands of Microsoft and Intel. In spite of the problems with the thesis, it does contain a grain of truth. There are times when many small machines can replace large, centrally located ones, and do a better job. Cold fusion looks like it may become an ideal example.

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Development of Advanced Concepts for Nuclear Processes in Deuterated Metals

EPRI TR-104195, Research Project 3170-01, Final Report, August 1994,
128 pages, plus 342 pages on microfiche. **$200**
Authors: McKubre, M. C. H., et al.,

Review by Jed Rothwell

This is one of the most comprehensive descriptions of a set of cold fusion experiments ever published. The only reports I know of that rival it are from F.G. Will et al.,[1,2] and M. H. Miles et al.[3] This EPRI book describes the research paid for by EPRI and performed at SRI International between 1989 and 1994 by M. McKubre, S. Crouch-Baker, F. Tanzella and eight other principal investigators. These are among the most careful cold fusion experiments ever done. The results are unequivocal. They were first described in 1991, and summarized in McKubre's 1992 lecture notice at MIT:

Comprehensive, Meticulous and Definitive

Unaccounted, and statistically significant heat excesses have been observed on more than 40 occasions. The excess energies of these observations are larger than can be accounted for by known chemical or mechanical energy storage processes. Observations of excess power and energy are strongly correlated with the measured D/Pd ratio, to the imposed cathodic current density, and to a third process of unknown origin, with an extended time constant.

There is no room for doubt about these results. They are far above noise levels and potential errors, which were established with almost fanatical precision. (See the sidebar "Fifty Sigma Results.") Figure 1 shows an example in which total uncertainty from noise and potential errors was established at less than 0.1 watts, total electrolysis input (not shown here) was ten watts, and the excess ranged from 0.9 to 1.0 watts for 192 hours (8 days). While this is 'only' 10% excess, the Uncertainty line is far below Excess Power. This was established with exhaustive procedures described in detail in the text. For example, inlet and outlet temperatures were measured with two thermocouples at the inlet, and two at the outlet, with an accuracy of ± 0.001K. Here is how the flow rate was maintained and measured in experiments P12 through P16:

The heat transfer fluid was pumped from the bath and past the cell inside the calorimeter volume by Fluid Metering, Inc. (Oyster Bay, NY), mode QV-OSSY constant displacement pumps. The mass flow rate was determined by pumping the flow to an auto-siphon device placed on a Setra model 5000L digital balance. Precautions were taken to ensure that fluid was not lost following its transit through the cell and before flow rate determination.

This method allows accuracy of better than 0.01%; that is, 200 ± 0.01g per 240 ± 0.01 seconds. In a number of experiments rotometers were also employed.

Great effort was devoted to quantifying and reducing already-small errors, like the heat loss from conduction of the electrode and thermocouple lead wires going into the cell. Most workers ignore such factors because they are so small compared to the excess heat.

SRI has an interesting approach to doing control or blank experiments, in addition to the usual use of platinum electrodes:

In general, two different experiments were performed simultaneously in the same bath the electrochemical cells were connected electrically in series, but the calorimetric systems were hydraulically in parallel. Separate pumps were provided for each calorimeter, and the flows from the two cells were multiplexed to a single mass balance. All measurements were multiplexed to a single multimeter that was periodically interchanged with another precalibrated meter. In this way, one series cell effectively acted as a standard for the other: if P_{excess} was observed not to be zero in one cell while it was zero in another, this difference was unlikely to be an artifact due to current source or voltmeter miscalibration. Further, the current-measuring resistors were interchanged, replaced, and removed and recalibrated during periods of excess power production, a procedure that reduced the likelihood that errors were associated with the measurement of current.

These details give you a sense of how much effort went into the experiments.

The tone of the writing is conservative, emphasizing how much we do not know. It is painfully honest in places. Difficulties and equipment failures are described in detail. You get a sense you are watching over someone's shoulder in the lab, or leafing through a lab notebook. The authors take nothing for granted. Most people simply state the cold fusion reaction must be beyond chemistry because it produces so much heat from such a small mass. In this book they quantitatively prove that assertion, by listing an inventory of chemicals in the cell, every possible chemical reaction, and the mass of all

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reactants in the cell. (See sidebar "Overkill Example.") They compute total joules from the reactants and show that only 2 to 3% of the excess heat could have come from chemistry. This is overkill; it is proving the obvious in meticulous detail. It seems a little silly. But it is good to see the authors bulldoze away all possible arguments.

When the authors do not have definitive evidence for something, and they extrapolate, they always say so:

> **At very high fugacities . . . a distinct change in the slopes of the resistance/fugacity curves is apparent. This change of slope has been interpreted in terms of the occupation of tetrahedral sites at very high loadings. Firm crystallographic evidence, which has not yet been obtained, is required to substantiate this interpretation. [p. 2-8]**

So much care has been taken, and so many doubts have been expressed and then laid to rest, that when they finally get around to making definitive claims you feel they must be on solid ground.

A Triumph, Yet Flawed

In spite the overall technical excellence of this work, it is flawed, for several reasons:

- Since 1989 SRI has made little progress. The cells do not produce more excess heat. Reliability and reproducibility have not improved. SRI is no closer to practical technology than they were in 1989. They do not appear to have made much progress solving the scientific problems either.
- SRI has been slow to try new techniques and materials like nickel or thin film and wire palladium. They have used bulk palladium and heavy water almost exclusively. (They tested loading with wire palladium.)
- These results are definitive, but they are not as dramatic as the boil-off experiments reported by Pons and Fleischmann in 1993. [4]
- The calorimeter has taken so many resources that other aspects of the research, like material sciences, have apparently been shortchanged.
- In a sense, the calorimeter is too good. It is finicky, and difficult to use. It takes a great deal of effort to set up an experiment with it. This does not encourage a spur-of-the-moment test of a new idea. A scientist who once worked with the calorimeter calls it "the great white elephant." The complexity precludes many interesting experiments. For example, in about five minutes, Storms can turn off an experiment, open up his calorimeter, remove the cathode, weigh it and test it in various ways before it degases significantly or changes in other ways. Some spots in the cathode may even still be reacting after ten minutes, in heat-after-death reaction. Removing the cathode from the complex SRI calorimeter take an hour or more. By the time the cathode can be placed on a scale or in a detection instrument, its composition and properties may change drastically. Any lingering heat-after-death reactions will surely stop.
- As McKubre said in his closing remarks at ICCF6, this calorimeter is designed to maintain a steady state, yet most people think it is essential to jolt the cold fusion cell with rapidly changing conditions.[5] McKubre now questions whether this was a "wise" choice of designs. Other scientists expressed these doubts years ago.
- After the tragic, fatal accident in 1992, the laboratory was arranged with the calorimeter and all instruments in a locked area surrounded by bulletproof glass. During an experimental run, the workers are not allowed to go near the experiment. Scientists from outside of SRI have told me this is impossibly restrictive. Hands-on contact with the instruments is vital.

Some other cold fusion scientists express dissatisfaction and resentment toward SRI. They feel that with all of the resources and talent at SRI, more progress should have been made. They say the research has been misguided, the wrong goals have been set, mistakes like the calorimeter design have been left in place too long. The calorimeter should have been simplified and changed to allow rapid changes. New, more innovative techniques and materials like nickel should have been tried. More attention should have been paid to materials, techniques, and the operating temperature, and less to improving the calorimetry.

The establishment should have taken notice years ago. But it did not. To say the least, this calls into question the traditional model of scientific progress.

Edmund Storms described the root of the problem. He thinks that SRI's research has been too much influenced by the opposition. Skeptical doubts and objections should not be ignored, but they should not be elevated to become the overwhelming design criteria for the experiment. Storms warns of "falling into the tarpit of other people's expectations" in "a research agenda driven by skeptics." The skeptics claimed that extreme precision is needed to prove the cold fusion effect exists. In fact, says Storms, such precision is not needed, and it adds no statistically meaningful confidence to the data. Fifty sigma results are not "more convincing" than 25 sigma ones. He feels that McKubre went too far when he did things like track heat losses via the thermocouple leads. He also believes that it is better to boost the signal by improving cathode materials than it is to relentlessly reduce the noise the way SRI has done. McKubre, upon hearing Storms' comments, protested that they have been trying to do both. It is a question of emphasis, and deciding which should be given a higher priority. Storms and I lean toward boosting the signal. McKubre has not sufficiently explored the kinds of techniques Storms describes. (Or if he has explored them, he did not describe the work here.) In the end, at ICCF6, McKubre agreed that the concerns of the skeptics may have interfered with good experiment design. He said:

> **What we have done in part, partly in response to our critics, is to make calorimeters in such a way as to improve the data quality. You improve the data quality by averaging things for a long time, never changing anything . . . In doing that, of course, you maintain the system as closely as possible in a steady state. We have engineered and designed our systems to do that. That is what flow calorimeters do well. I question, now, whether that is wise.[5]**

The Establishment Not Convinced

The biggest problem with the SRI results is that they have not convinced the wider scientific community and the scientific establishment that cold fusion is real and important. This, of course, is establishment's fault, not SRI's. These results were duly published in major, peer reviewed scientific journals long ago.[6] The work was described in articles in the *Wall Street Journal*, on ABC, National Public Radio, and in lectures at MIT, at the International Conferences, and elsewhere. The establishment should have taken notice years ago. But it did not. To say the least, this calls into question the traditional model of scientific progress.

EPRI and SRI have followed the rules. They have done what scientists are supposed to do: they published impeccable, utterly convincing research in top-ranking, peer-reviewed journals. Then they stood quietly aside, politely waiting for applause and recognition. The applause never came, and by now it is obvious that it never will come. McKubre feels that cold fusion will only attract attention when it can be demonstrated as a viable technology. He

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regrets that he has not been able to do that. In June 1996, during an interview on National Public Radio, he said:

> **People's attention needs to be grabbed by something that's simple, unarguable, concrete and rugged, and it has to be simple enough to explain it to the average person or average politician. And it really has to be a lot more robust than anything that we have generated so far.**

He is right. We probably do need simple and rugged machines. That is a shame and it is unfair to McKubre and other cold fusion scientists. McKubre's experiment is unarguable. It should not have to be simple, concrete or rugged. These have never been held as standards for believability in science. Things like the Fermilab top quark-finding machine and hot fusion reactors are as far from being "simple and rugged" as anything can be.

SRI could have done more to convince the public with what they have already. Neither SRI nor EPRI has made efforts to publicize the result beyond the usual methods of publishing in technical journals and lecturing at conferences. They have not held press conferences, or gone out of their way to attract media attention. They have made no effort to "explain it to the average person or average politician." SRI's scientific papers are models of clarity and good expository writing, but they are challenging to read. I could easily explain SRI's experiments, their results, and the significance of the results in language that an average person or politician would understand. Anyone with experience writing computer manuals could do it. SRI has never tried.

Why has SRI shied away from press conferences and Sunday Supplement simplified explanations of their research? Part of the reason may be because cold fusion scientists have been attacked because of the perceived fiasco of the 1989 University of Utah press conference. Critics say that cold fusion is "science by press conference." McKubre and others have been careful to avoid that stigma. In fact, the "science by press conference" accusation is gross hypocrisy. Science is always done by press conference, and it always has been. Major experiments at the hot fusion Tokamak reactors are featured on the seven o'clock news and the front pages months before scientific papers are published.[7] Things like the Hubble Telescope; possible traces of life on Mars in Antarctic rocks that might have come from Mars; progress in AIDS, and other major science stories are orchestrated and hyped every day in the media and in Congress. There was nothing wrong with holding a press conference in 1989, and certainly nothing unusual about it. They should have held a dozen more press conferences. The only problem with the Utah announcement was that preprints of the Pons and Fleischmann paper were not made available that day, in the auditorium.

Internal politics may be another reason SRI has kept this work obscure. There is a great deal of hostile opposition to cold fusion within EPRI, from people like Tom.Schneider, as expressed in his Introduction to Hoffman's book *A Dialog on Chemically Induced Nuclear Effects*.[8,9] This internal opposition eventually led EPRI to stop funding most of the research at SRI. The Japanese NHE program is now funding it instead. The supporters of cold fusion within EPRI and SRI should change their political strategy. They have stuck with it long after flaws were revealed, just as they stuck with the calorimeter design and experimental protocols for too long.

Nuclear Evidence

The book contains a short section on the search for evidence of a nuclear reaction. They found no significant helium or transmutations of the host metal, but they did find evidence of radiation in an autoradiograph (Fig. 2).

> **Clear evidence of some type of ionizing radiation is observed. The points of light with diffuse halo exposure suggest that some type of radiation may be coming from point sources within the metal and being scattered by the lattice structure. *p. 3-19***

Approximately 10% of the total mass of some cathodes, including parts of the surface and bulk, were analyzed by Rockwell International for helium. No significant levels of helium were found. Based on the work of Miles and others, it seems likely that if helium was generated by the reaction, it would have escaped into the electrolyte. The surface and near surface were subjected to laser ionization (SALI) to look for evidence of fission transmutation: changes in isotopic composition and expected elements. None were found. It is a shame they did not look more deeply, where Mizuno and Minevski found transmuted metal. The authors do not think they can confirm or deny the nuclear hypothesis. They write:

> **We can conclude that if a nuclear process gives rise to the heat, it does so largely by the production of stable nuclei which so far have not been detected but have not yet been seriously sought.**

According to Tom Passell of EPRI, not "seriously sought" means that helium has been detected but sources of contamination, like helium leaking in from the air, have not yet been rigorously excluded.

After the book was published, Passell began a series of experiments looking for transmutations in the used SRI cathodes, using prompt gamma activation analysis (PGAA). He believes he has found an ~18% reduction in the ratio of boron-10 to palladium-105 in a cathode that generated excess heat at SRI.[10] This work is still underway.

The Report Summary makes a bold claim about nuclear evidence:

> **Although nuclear reaction products commensurate with the excess heat have not yet been observed, small but definite evidence of nuclear reactions have been detected at levels some 40 orders of magnitude greater than predicted by conventional nuclear theory.**

Passell explained that the "40 orders of magnitude" refers to research in other labs, particularly in neutron detection.

Confusion about Percentages and Electron Volts Per Atom

In two or three places, the book repeats a statement summarizing results. This was also included in the 1991 ICCF2 paper:

> **For the thermodynamically closed and intentionally isothermal systems described here, output power was observed to be as much as 300% in excess of the electrochemical input power or 24% above the known total input power. When excess power was present, it was more typically in the range 5%-10%, in a calorimeter that was accurate to better than +0.5%. The largest excess energy observed corresponded to 1.08 MJ, or 45.1 MJ/mol, or ~450 eV/atom normalized to the Pd lattice or to the deuterium in the palladium at a loading of ~1. *p. 1-5***

Variations of this 5% to 10% number appear. A table (3.1, p. 3-3) shows Total Energy Excess in megajoules and percent for 15 experiments. The percent numbers range from 0.24 to 3.88%. These are meaningless averages. The 0.24% represents the total excess heat generated by the cathode compared to all sources of energy that went into the cell during the entire experimental run, including the initial incubation period, which sometimes lasted for weeks, starting with one week preparation at low current. Unfortunately, Morrison and other members of the opposition frequently quote these averages out of context, spreading doubts and confusion. They say that a mere 0.24, or 3.88 or 5% excess must be close to the noise. This like asserting that I drive 10 miles per day, so my car goes an average of 0.42 miles per hour during the 24-hour day, so it would be faster to walk. When the car is moving, it goes much faster than 0.42 mph. When the SRI cells produce excess heat, they usually produce much more than 0.24%.

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The average is much lower than it would be in most cold fusion experiments, because of the design of the SRI calorimeter. SRI employs a compensation heater to keep the temperature in the cell the same throughout the experiment. When the experiment begins, the compensation heater is turned on high; power from electrolysis and excess heat is zero. When electrolysis goes on, the compensation heater automatically decreases to balance. Heater plus electrolysis power together keep the cell at the same temperature as the heater alone did at the beginning. When excess heat turns on, the heater power decreases again. When excess heat fades away, the compensation heater turns back up. The point is, this 0.24% excess represents the excess energy compared to all of the energy input into the cell from all sources, including the compensation heater. In most other experiments, there is no compensation heater; cell temperature is allowed to increase and decrease freely.

This confusion about percentages is compounded by another pernicious "skeptical" argument: the stored energy hypothesis. It has often been asserted, even by scientists like Frank Close, that a cold fusion cell is some kind of energy storage battery. The idea is that the electrical energy input during electrolysis is stored in chemical bonds (electron bonds), and then released later in the form of heat. David Williams, Professor of Chemistry at University College London, believes in the battery hypothesis. He calls cold fusion "an inefficient, unreliable, dangerous and expensive energy storage method." If cold fusion is anything like a battery storage system, it must be millions of times more efficient than any other form of chemical storage, and it violates the established laws of chemistry.

McKubre specifies the order-of-magnitude energy release per atom of the cathode material as 240 eV (electron volts) per atom of cathode material. Pons and Fleischmann and others also use this standard. They have seen much higher energy releases, thousands and even hundreds of thousands of eV per atom. McKubre's statement "~450 eV/atom normalized to the Pd lattice" should make all skeptics realize that chemical energy storage is impossible, but even after six years the arguments continue, so I will point out some basic physics that McKubre does not spell out.

The largest amount energy that can be stored in any electron bond has long been established by both theory and experiment. Most high energy density reactions, like burning coal, release 2 to 4 electron volts (eV) per atom. Some exotic reactions might theoretically produce as much as 18 eV per atom, but this has not been observed.[11] Therefore, a release of hundreds or thousands of eV per atom is far beyond the limits of chemistry.

Some skeptics have said that the energy release should be normalized against all of the hydrogen atoms in the system, not just those in the palladium lattice. There is far more hydrogen in the water than in the lattice. This makes no sense. The heat originates inside the cathode. The hydrogen in the water is chemically inert; water does not burn. Some new hydrogen from the water is pushed into the cathode from electrolysis, but the cathode is already supersaturated. The new hydrogen merely displaces some of the old hydrogen, which bubbles out, rises to the surface, and is recombined with free oxygen. This mechanism alone would not produce any excess heat. When an atom is pushed into a lattice and it displaces another, there is no net gain or loss of chemical energy, because no new chemicals are formed. Some skeptics have suggested that the new hydrogen atoms entering the lattice "surrender their energy," whatever that might mean. Then they leave, to be replaced with others, which surrender more energy. No known mechanism would allow this to happen, and even if it did happen, it would only act as a heat pump, cooling the electrolyte and warming the cathode, with no net excess heat from the cell.

Finally, it should be noted that energy is not stored up during periods when there is no excess heat. Except for the initial loading period when the palladium hydride is formed in a few hours, input is balanced by output as closely as can be measured. If energy was being stored up in a battery, the reaction would be endothermic: the heat energy output would be less than the electrical energy input. But when a cold fusion cell does not produce excess heat, all of the electrical energy that goes in comes right out again in the form of heat. Some energy is first converted to chemical energy in the form of free oxygen and deuterium gas, but in the closed SRI calorimeter, the gas is recombined back into heavy water, and the energy is released in the form of heat. The skeptics counter that perhaps the energy is stored up very slowly, at tiny power levels that cannot be detected. During the two-week incubation period that precedes the onset of excess heat, the skeptics claim that the cell is absorbing a few milliwatts of heat, at power levels too small to be detected by the calorimeter. This might be the case with ordinary calorimeters, but the SRI calorimeter is so sensitive it would detect the imbalance. The negative (endothermic) power levels preceding the largest bursts would be well above the noise level.

Current Reversal Technique

The book describes an interesting technique which has not been highlighted in other publications or lectures. To help keep the cathode clean, the workers periodically "strip" the cathode by reversing the current and making the cathode into the anode and vice versa. (That is, they make the palladium electrode positively charged, instead of negative, so that it attracts oxygen instead of hydrogen.) This was described in a paragraph that gives the reader a sense he is looking over someone's shoulder, watching a group of skilled people make mistakes that lead to fruitful discoveries.

> **3A.3.4 Period 4**
>
> **Unaware of the possible existence of excess power within the calorimeter, the operators prepared to anodically strip the cathode surface at a low current density by first reducing the current to 30 mA (~10 mA cm^{-2}) and then reversing the current. This sequence led to extraordinary observations of resistance and thermal anomalies, shown respectively in Figures 3A-4B and 3A-4f.** ***p. 3A-8***

Passell explained that by making the anode a cathode for a while, you dissolve some of the metal surface. He describes this as a "major technique" to boost loading.

Heat Promotes the Cold Fusion Reaction

The book ends with an all-too-brief discussion of the role of heat in promoting the reaction, a topic critical to the science of cold fusion:

> **The apparent discrepancy between our observation of a roughly linear dependence of excess power on current density and that of Fleischmann and Pons of a roughly second-order dependence may be resolved by understanding the influence of temperature. We have designed our experiments, as closely as possible, to decouple the influences of temperature and current density; calorimetric experiments are performed under constant input power conditions, approaching the steady state. Our calorimeters also have large heat conduction so that, even in the condition of substantial excess power, the cathode temperature is not raised appreciably. Under these conditions, we observe an approximately linear response of excess power with current density.**
>
> **In the experiments of Pons and Fleischmann, the current density is raised without reducing the power in a compensatory heater, in a calorimeter with very low heat conduction. For this reason, the cell temperature rises markedly with increasing current density, and the temperature increase is exacerbated by the onset of any excess power production. Under these conditions, Fleischmann and Pons observed a second-order or higher power dependence of excess power on current density, with no observed maximum.**

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Taken together, these results suggest that the rate of excess enthalpy production increases at least transiently, with increasing temperature. Such a degree of autocatalysis would be useful in achieving large power gain; the apparent positive derivative with temperature suggests that it may be possible to produce heat efficiently at a usefully elevated temperature. ***p. 5.5***

McKubre did not always succeed in decoupling the influence of temperature. In my review of ICCF6[12](see *IE* #10), I described an incident cited by McKubre in which a heat burst was caused when the flow was accidentally blocked and the cathode temperature rose higher than planned. The event was shown in two graphs from the ICCF4 proceedings (Fig 3, 4).[12] The flow was blocked just before hour 1952 for four hours, when a piece of black electrical tape got into the pipe. This was discovered just before hour 1956, the problem was corrected, and the excess heat began to drop, fading an hour later. Total energy from the burst was 368 kilojoules. If I had been in charge of the research, I would have immediately throttled the flow again to see if that caused another heat burst. Many important scientific discoveries have been made by following up such fortuitous accidents. Yet this incident is not described in the Final Report. I see no evidence that the people at SRI followed up on it. As far as I know, nobody working with the flow calorimeters IMRA or the NHE lab has tried throttling the flow.

Acknowledgment

Dr. Tom Passell of EPRI was most helpful to me in my quest to understand this EPRI publication. He answered numerous questions with enthusiasm, panache, and outspoken honesty.

Footnotes

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5. M.C.H. McKubre, J. O'M. Bockris, "ICCF6 Summary and Reviews," *Infinite Energy*, #10, p. 25

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8. N. Hoffman, A Dialog on Chemically Induced Nuclear Effects, American Nuclear Society (1993)

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11. R. Forward, "Alternate Propulsion Energy Sources," Air Force Rocket Propulsion Laboratory TR-83-039, May 1983.

12. J. Rothwell, "Review of ICCF6," *Infinite Energy* #10, p. 13

13. M. McKubre, "Loading, Calorimetric and Nuclear Investigation of the D/Pd System," *Proc. 4th Int. Conf. on Cold Fusion*, Lahaina, Maui, EPRI TR-104188, Vol. 1, p. 5-22 - 5-23.

Fifty Sigma Results

The introduction to this volume leaves no doubt that authors believe they have fully reproduced and confirmed the cold fusion effect. This is an unequivocal endorsement of the claims of Pons and Fleischmann:

EPRI PERSPECTIVE

This work confirms the claims of Fleischmann, Pons, and Hawkins of the production of excess heat in deuterium-loaded palladium cathodes at levels too large for chemical transformation. However, the phenomena were obtained in only about half the cells. From the conditions of loading, initiation time, and current density on the successful observations of excess heat, it is understood why the phenomena are so difficult to attain. The conditions in the successful cells were not entirely under experimental control because the closed cells slowly leach silica and other materials from the anode and its supports as well as from the cell walls . . .

The primary objective of further work on this subject will be to demonstrate which nuclear reactions, if any, are generating the excess heat. The only way to do this is to observe in at least roughly quantitative fashion the nuclear reaction products or "ashes." At this time, it is thought that the most likely ashes will be helium of mass 4 observable in the vapor phase of closed cells. The reaction producing helium needs to be known in order to maximize this excess heat phenomena for practical uses in the nuclear power industry.

- Introduction

We do not claim to have examined all possible sources of systematic error in our calorimetry. However, highly instrumented and monitored experiments, using calorimeters of considerably different design and principle, have resulted in qualitatively and quantitatively similar results, i.e., apparent excess heat bursts outside the standard deviation of the random errors by factors up to 50. *p. 3-23*

CONTENTS

This report consists of ten major sections; seven printed on paper, three on microfiche. It is too bad the entire book was not produced on CD-ROM and made available via the Internet World Wide Web. It would be much easier to use in electronic form; the page numbering is confusing, and there is no index. It includes 60 illustrations, graphs, charts and schematics; and five tables. This is a comprehensive, expensive book. It is somewhat repetitive. Much of the text was previously published in conference proceedings and peer-reviewed papers. The text is not as repetitive as it first appears. The equipment was modified and improved before each set of tests. It is described again in each section, using text that has been copied and modified.

This book does not cover all of the SRI work on cold fusion. It does not include anything about the loading studies with palladium wire and other topics covered in some of McKubre's lectures. This work will be covered in another volume, Research Project 3170-01.

For a shorter look at the SRI experiments, see the article in the Journal of Electroanalytical Chemistry. [6]

Here are the section numbers and titles:

1. Introduction
2. Degree-of-loading Studies
3. Calorimetric Studies
3A. Experiment P19: A Comprehensive Data Compilation
3B. Experiment P1b
4. Nuclear Detection Experiments
5. Summary and Discussion

APPENDICES (Microfiche)
A. Lockheed Report - Nuclear Detector Experiments
B. Patents Disclosure
C. Accident Investigation Report

Item C. refers to the tragic accident on January 2, 1992, in which Dr. Andrew Riley was killed. This was also described in: S.I. Smedley et al., "The January 2, 1992, Explosion in a Deuterium / Palladium Electrolytic System at SRI International," *Frontiers of Cold Fusion*; *Proc. 3rd Int. Conf. Cold Fusion*, Nagoya, 1992, Universal Academy Press, Tokyo, 1993

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Overkill Example

When a cold fusion cell produces megajoules of energy per mole of cathode material, most scientists consider that proof of excess heat "beyond the limits of chemistry," like a match that burns for an hour. The authors of most other cold fusion papers have never bothered to quantify this assertion; they merely list the total energy output and leave to the reader to draw the obvious conclusion. In the SRI book, no assertion is left uncorroborated, even one as indisputable as this. They take the "skeptical" argument seriously, long enough to dispose of it. Experiment P19 produced 790 kJ of excess energy, mainly in three bursts. An inventory of chemicals in the cell; all known chemical reactions; and the total energy these reactions could produce are shown on pages p. 3A-14 through 3A-16. Here is the inventory:

		Species	Mols
Solid Phase	*Cathode	Pd	0.024
		D	0.023
	Anode	Pt	0.016
Solid + liquid phase		B	0.0004
Liquid phase		Li	0.02
Gas phase		D_2	0.002
		O_2	0.001
		D_2O	0.024

* A footnote here shows the level of detail taken into account: "Other solid parts are Al_2O_3, SiO_2 and PTFE, which are considered in this analysis to be nonreactive.

Reactions and (approximate) energy releases are:

[1] $PdD_x \Leftrightarrow Pd + D_2$ ~1 kJ mol^{-1}

[2] $D_2 + 1/2\ O_2 \Leftrightarrow D_2O$ ~290 kJ mol^{-1}

[3] $2\ Li + 1/2\ O_2 + D_2O \Leftrightarrow 2\ LiOD$ ~683 kJ mol^{-1}

[4] $2B + 3/2\ O_2 \Leftrightarrow B_2O_3$ ~127 kJ mol^{-1}

An in-depth discussion of these reactions shows they are extremely unlikely because, for example, there is no "unlimited supply of oxygen" in the cell. If we assume oxygen does somehow get in, the four reactions would produce a total of 7 kJ, less than 1% of the total, or 3% of the energy produced by the larger continuous heat bursts.

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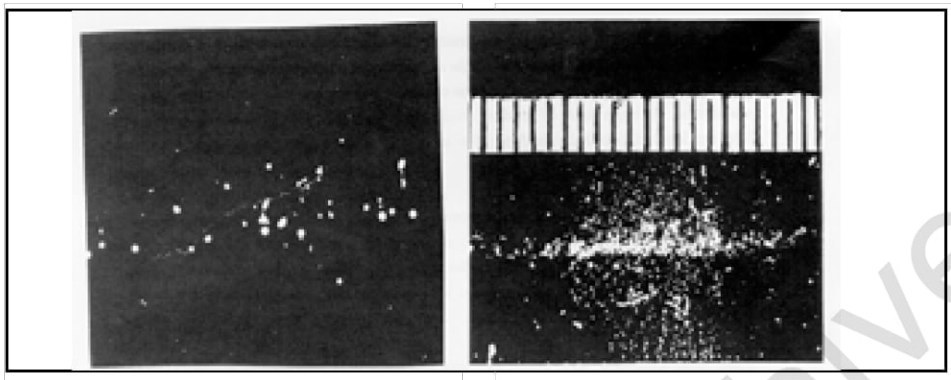

Figure 1. SRI Autoradiograph of Palladium Rod

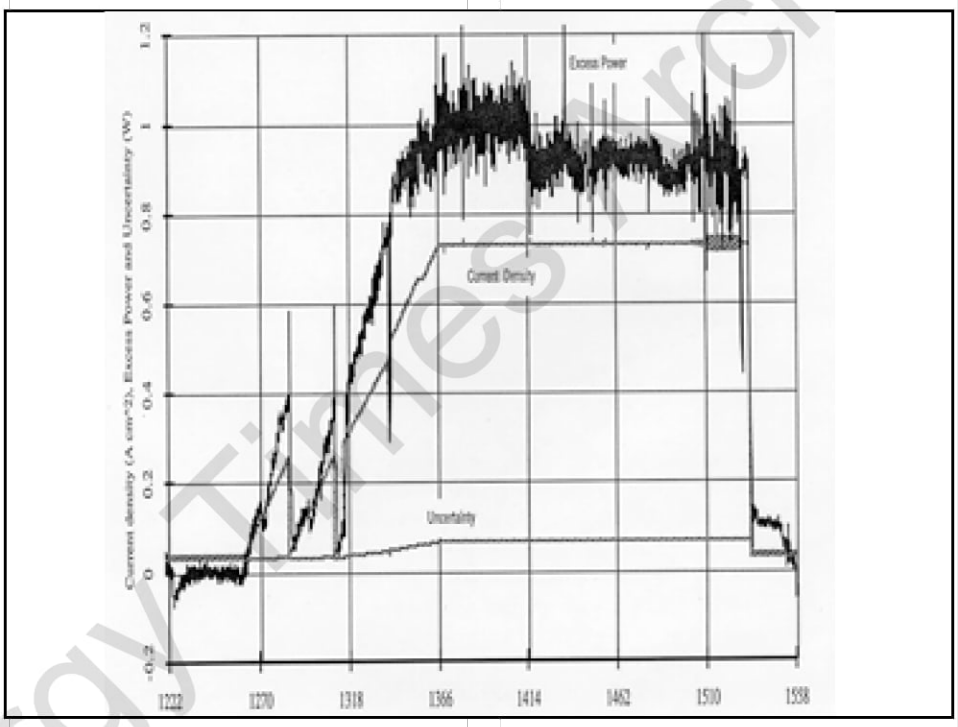

Figure 2. EPRI Report Figure 3-14

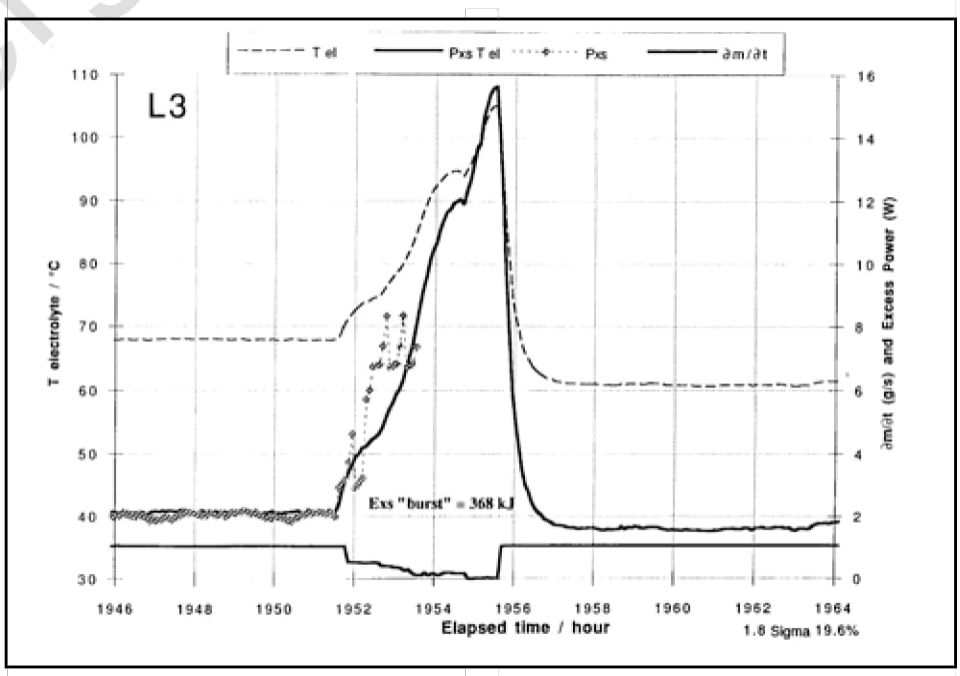

Figure 3. SRI Excess power burst

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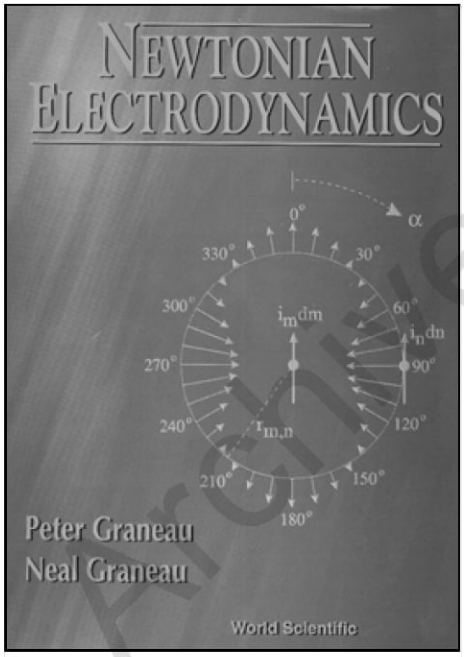
Book Review.... by Thomas E. Phipps, Jr. 908 South Busey Avenue, Urbana, IL 61802

Newtonian Electrodynamics

by Peter and Neal Graneau (World Scientific, Singapore, 1996)
ISBN 981-02-2284-X (Hardback, US $58), 288 pages
ISBN 981-02-2681-0 (Paperback US $36)

Reprinted (and expanded) with kind permission from *Galilean Electrodynamics*, January/February 1997, Vol.8, No.1 [*Galilean Electrodyanmics*, 141 Rhinecliff Street, Arlington, Massachusetts 02174, Editor: Dr. Cynthia Kolb Whitney]



This handsome little book has something important to say that will not be at all unfamiliar to readers of this journal [*Galilean Electrodynamics*]. The message is sufficiently simple to be symbolized by the figure on the dust jacket. This shows a polar diagram of the original Ampère law of forces between two parallel "current elements." This encapsulates the *Ampère's law* that the authors have labored through recent years to confirm by a great multiplicity of experiments, as reported in this book and in others such as ***Newton vs. Einstein*** and Peter Graneau's earlier classic, **Ampère-Neumann Electrodynamics of Metals**, of which a second edition has recently been issued. In this connection it is important to set the historical record straight: The "Ampère's law" that that great physicist ("the Newton of electricity") actually announced in the early 1820's has nothing to do with what modern textbooks choose to designate by that term (i. e., something involving a so-called magnetic "field" that would have mystified Ampère). The clerks who write these textbooks are guilty of a double treason — treason to history, in misrepresenting Ampére's actual findings, and treason to physics, in suppressing an important empirical discovery that fails to fit their Procrustean ideology of Lorentz covariance. The resulting confusion of terminology forces us to refer to "Ampére's original law," to make it plain that we are talking about a Newtonian force law, a pure empiricism devoid of "field" extrapolations — something quite different from the "law" attributed to Ampere in modern texts.

The book contains seven chapters. The first outlines the history of electromagnetic description, including the dueling force laws of Ampère and Grassmann, Kirchoff's circuit theory, etc. This establishes that "Newtonian" (instant-action) electrodynamics was already a going concern long before field theory made its appearance. Some aspects of pre-Maxwellian electrodynamics seem today incredibly prescient: For instance in 1857 Kirchoff, *using the instant-action theory of Weber,* established that transmission lines propagate "causally delayed" signals at speed c — and Assis has lately shown that this result is independent of some of the restrictive assumptions underlying the Kirchoff analysis. It seems a short step from this to a mathematical modeling of the vacuum as a "transmission line," as Gray has recently demonstrated [1]. This may provide the beginnings of an answer to the otherwise baffling failure of Weber-type instant-action theories, so effective in treating forces, to describe radiation. The prospects for neo-Newtonian theory in this direction seem very exciting.

The next chapter, "Experimental Demonstration of Longitudinal Ampère Forces," gets into the meat of the numerous empirical demonstrations by the Graneaus and others that "current elements" exert on each other longitudinal components of ponderomotive force — in contradiction of the Lorentz force law, which allows only actions transverse to current flow. The evidence ranges from longitudinally exploding wires under the action of high currents to a repetition of Ampère's own "hairpin" experiment by which he convinced himself of the validity of his longitudinal force claims. One of the neatest of these experiments is a "liquid mercury fountain," by which the Graneaus have shown the superior descriptive power of Ampère's longitudinal forces, as compared with the Lorentz pinch effect. Some subtlety of experimentation is required, since the laws of Ampère and Lorentz, as well as many other proposed variants, differ only by exact differential quantities, which integrate to zero around any closed loop - under the vital but seldom-noted condition of *uniform conductive and inertial properties around the loop*. The evidence, however, continues to pile up from experiments that violate this condition. The latest is a repetition by Neal Graneau at Oxford of that Robson-Sethian experiment [2] which purported by a null observation to disprove Ampère longitudinal forces. Through a slight but crucial modification of the geometry of the earlier experiment (use of unequal arc gaps), positive results were obtained, quantitatively explicable by the Ampère original force law and qualitatively inexplicable by the Lorentz law. Understanding of the observed result hinges on an issue of "inertial modulation" of electrodynamic force lying wholly within the province of Newtonian physics.

...the etiquette of modern physics decrees that experiment may sit at High Table with theory only if theory lends it a collar and a fashionable necktie.

The number and variety of "proofs" of the existence of electromagnetic longitudinal force actions given in this chapter and elsewhere in the book, and the notable lack of counter-proofs, are such that, if the data spoke in a trendier cause, advocates would be trumpeting hosannas borrowed from the relativists; e.g., "...one of the empirically best-supported aspects of physics." But the etiquette of modern physics decrees that experiment may sit at High Table with theory only if theory lends it a collar and a fashionable necktie.

The next two chapters deal with the application of computers to Ampère force and related calculations, particularly inductance calculations. There is in this connection also some treatment of Maxwell's powerful but seldom-clarified geometric mean distance (GMD) method for such calculations. More on this would have been welcome, as Maxwell's own exposition in his treatise leaves it one of the minor mystery areas of classical physics. At the heart of the "finite current element" calculational method espoused by these authors is the physical definition or identification of the "current element." This, no trivial matter, is worthy of the separate chapter devoted to it; as current elements in solid conductive materials manifestly

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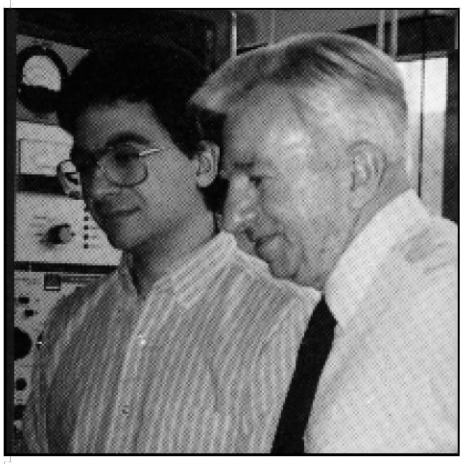
submit to ponderomotive actions. This would hardly be true if they were, as Lorentz conceived, merely products of (electronic) charge and electron transport velocity — for in that case actions would be strictly electromotive. The Graneaus go extensively into the physics of this subject, and argue finally for the anchored, polarized *atom* in the conductive material as the ultimate (discrete or finite) "current element." This is perhaps the most controversial aspect of their studies, on which it is possible that quantum mechanics and solid state theory might cast further or different light. For practical purposes, however, an entirely different physics of the ultimate "element" might have little effect on the actual computations, since computer limitations intervene long before the "ultimate" level of physical analysis is reached. Their method avoids traditional difficulties with mathematical singularities and is infinitely flexible as to conductor shape. It certainly deserves a prominent



Drs. Neal (L) and Peter Graneau

place in the analyst's arsenal of methods, along with GMD and others, such as current density (six-fold) integration, the filamentary approximation, Monte Carlo, etc.

The next two chapters treat railgun evidence and arc explosions, particularly underwater arcs. The observations furnish further convincing proofs that Lorentz "pinch" effects are entirely inadequate to account for what is known empirically in these important electrodynamic application areas, whereas Ampère forces serve very well. For example, although the Lorentz force law, by virtue of its integrated "loop equivalence" to the Ampère law, can give a good account of the total force exerted on a railgun armature, it cannot give even a remotely plausible account of the *location of reaction forces* distributed within the physical assemblage. The Ampère law, being Newtonian in provenance, has no difficulty. Another interesting sub-topic treated here is the cause of thunder, which turns out to be not so cut-and-dried as one might think.

Remarkable results for underwater arc explosions are reported. These are observed to have hundreds of times the explosive power that can be explained by either the Lorentz or Ampère force laws. We seem to have here a possible example of "over unity" energy production. Where is the extra energy coming from? The authors puzzle over this and sift through a variety of possible answers. Their conclusion, that a release of binding energy of water molecules may be triggered by the arc, seems certainly as plausible as any other that might spring to mind. There is obviously real physics here, patiently awaiting the notice of the Mighty of Theory, who currently have their consensus-burdened hands full with the complementary tasks of explaining sonoluminescence and dodging the explaining of cold fusion.

There is obviously real physics here, patiently awaiting the notice of the Mighty of Theory, who currently have their consensus-burdened hands full with the complementary tasks of explaining sonoluminescence and dodging the explaining of cold fusion.

A final chapter, "Electrodynamics in the Quest for New Energy," addresses itself to various unorthodox electrodynamic ways of possibly inducing nuclear fusion. These include capillary fusion, based on little-known work of Lochte-Holtgreven at the University of Kiel in the 1970's, plasma focus fusion, and solid fiber fusion (exploiting Ampère longitudinal forces). Such approaches to fusion typically involve directed motions of charged particles "aimed" to overcome the Coulomb barrier. They represent seemingly more intelligent approaches than the thermonuclear one, which demands isotropic velocity distributions. For this reason, of course, the community of physics professionals and assorted experts is dead set against them ... and government funding is so agile in following fashion as often to find itself leading, thus amplifying the instabilities of the scientific infantilism that fears pluralism and feels secure in consensus.

This book represents a remarkably dispassionate presentation of the case for the application of neo-Newtonian methods in the analysis of electrodynamic phenomena. It leaves the reader with little doubt that Ampère's original law of action between current elements possesses far greater hermeneutic power than the currently accepted Lorentz law. The latter would surely collapse under the weight of adverse experimental evidence, without relativity theory to prop it up. Highly recommended to the open-minded, and to any who agree with Maxwell about the "prudential" role of pluralism in ensuring the health of science and, indeed, in insuring its life.

By all who are less than fully satisfied with the status quo in the foundations of physics, this book may be recognized as a landmark. Depending on one's acquaintance with the history of science, it may mark the advent of a new current of thought, or the resurgence of an old one. Readers of this journal will be among those clearly implicated, since "Newtonian" and "Galilean" are synonymous in reference to electrodynamics.

The book opens, appropriately, with "Newton's first rule of reasoning," namely, "We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances." Probably nowadays we would say "necessary" rather than "true." One could write a book on the exegesis of this precept, and in a way this is what the authors have done. Of paramount importance is the emphasis on "appearances" — we might now speak of empirical observations, or "observables." Those who follow Einstein in plumbing the wellsprings of human inspiration for deeper or more uplifting insights than are offered by mere appearances will insist that "progress" has ratcheted and that the methodology of theoretical science has forever passed beyond its crude Newtonian beginnings. Yet the fact remains that, in every physical instance in which theoretical flights away from appearances have been made, ambiguities have arisen suggesting that — in the ever-presence of partial information — *sufficiency* may be something of a drug on the market and that no set of idealized preconceptions imposed on nature by the human mind possesses any unique claim to truth or *necessity* (Case in point: Both the Hertzian invariant formulation of electromagnetism [3] and the Maxwell-Einstein covariant formulation *suffice*, in that they agree regarding all the observables in any one laboratory — the former being a *covering theory* of the latter.)

In the matter of admitting causes extraneous to appearances, this has grown from a cottage industry in the hands of Maxwell (whose ether "cause," however, was quietly discarded) to the juggernaut of field theory, which nowadays would crush

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all opposition if there were any. Well, a principal message of this book is that, even today, there does exist a significant empirical basis for opposition to field theory, as well as a meaningful alternative line of physical description. In fact, historically, field theory was a late-comer upon the scene of electromagnetism. Maxwell originally sold the "field" concept by arguing eloquently for presuppositional *pluralism* as a prudential strategy in theoretical physics. His arguments for pluralism were and are impeccable; but again, like his ether, they were discarded by the subsequent "Maxwellians." Once those people found themselves politically in the saddle they exhibited toward pluralism exactly the same attitude as did their contemporary brethren in know-it-all-ism, the Bolsheviks.

The older religion based on Ampère's "current element" interaction law or Wilhelm Weber's velocity-dependent potential, with instant action-at-a-distance conforming to Newton's third law, was banished from the textbooks not through any inherent scientific failure or empirical refutation but through righteous political action implemented by that consensus which drives out pluralism, in the manner of Jehovah driving out Bel (or SI/m.k.s. driving out c.g.s.). No factual evidence against Newton's third law has ever been adduced, nor needs to be, now that the practitioners of physics have come in from the lonesome cold of empiricism to the teeming warmth of righteousness. (For by what else is "universal covariance," to take a prime example, buttressed?) Indeed, from the "mainstream" one hears much about consensus as the shortest road to truth; whereas to a disenchanted observer consensus seems an optimal social mechanism for eliminating all danger of too-early arrival at truth. This is the case because consensus (of authorities) operationally defines "truth" — thus at any moment of history manifestly obviating the troublesome further search for it ... except perhaps by a few maladjusted fanatics on what is known as "the dissident [read *lunatic*] fringe."

Thomas E. Phipps, Jr.,
6 December, 1996

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[1] R. I. Gray, *Phys. Essays* 8, 285 (1995).
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[3] T. E. Phipps, Jr., *Phys. Essays* 6, 249 (1993).

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Some people are beginning to suspect that the issues at hand may be much greater than "merely" infinite energy.—*EFM*

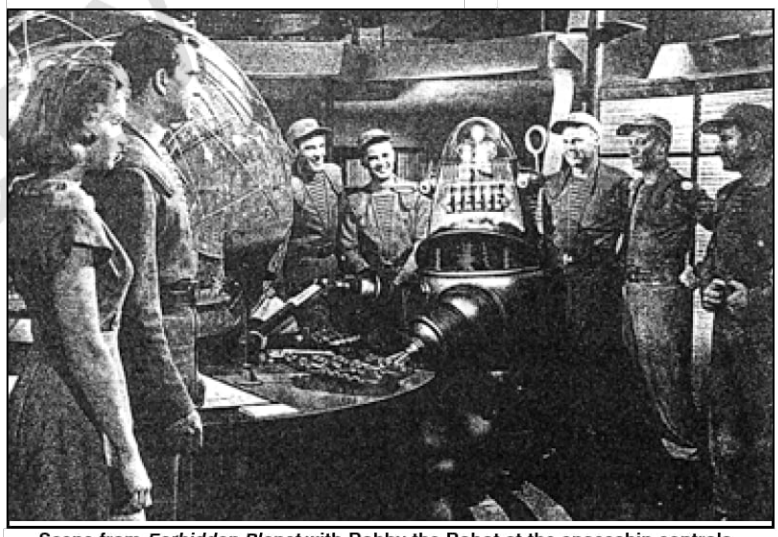
Commentary.....

Paradigm Shift for Subtle Energy — or *Altair IV, Anyone?*

by James A. Buzonas

In 1956 MGM released the movie *Forbidden Planet*, a stunning cinematic classic. I remember vividly the time when I first saw it — 37 years ago. Something was attacking United Planets Cruiser C-57-D, and it was winning. Some dark, incomprehensible "monster from the id" attacked the earthship and crew. Dr. Morbius, a philologist, twenty years before had cracked the language code of the Krell, the original inhabitants of Altair IV. They were a million years ahead of Earth, yet someone or some thing on that planet was even now dreaming dreams of lust, terror, and destruction.

How did this fictional device operate, even "in principle"? Consider the "life force," "soul force," "morphogenetic fields," or "morphic resonance" ideas of biologist Dr. Rupert Sheldrake. At one time a scholar of Clare College, Cambridge and a Frank Knox Fellow at Harvard University, Sheldrake put forth his ideas in his book *A New Science of Life: The Hypothesis of Morphic Resonance* (Park Street Press, Rochester, Vermont, 1995). Sheldrake postulates a morphogenetic field, which is non-electromagnetic and more subtle than electric or magnetic fields.



Scene from *Forbidden Planet* with Robby the Robot at the spaceship controls.

My conjecture along these lines is simple: psychotronics, radionics, noetic research, and parapsychology ultimately converge in a science of life, immanence self-transcendence, and consciousness—a "Science of the Spirit."

It remains to be seen whether Humankind will dare to take the "Krell test" of their collective intelligence, but biological researcher Glen Rein, Ph.D. in his book *Quantum Biology* (available through the International Tesla Society, Colorado Springs, Colorado) has already treated things called "subtle energies," such as David Bohm's "Quantum Potential" and "Super Quantum Potential."

I suggest we go back to Aristotle's *De Anima* (On the Soul), go back to Plato, Socrates, Plotinus, Pythagoras, Thomas Aquinas, and commentators on these authors. We should ask a little more closely: who am I, the knowing, loving, valuing subject? What type of being am I? Am I so bold as Prometheus as to give mortal man Krell-like secrets of the universe? Or do I detect the voice of conscience saying that I must first attain moral wisdom and perfection—and only *then* aspire after Infinity's casements of mystery?

Now back to the Krell of *Forbidden Planet* and a few time computations. According to Dr. Henry C. Monteith, a theoretical physicist who worked at Sandia National Labs for twenty years and who now teaches at East New Mexico University, Roswell, NM, knowledge doubles every five years. By this measure, we will be at the level of the Krell about 2,100 A.D., knowledge being a million times greater than now. Monteith thinks we'll be at the level of the Krell—being able to project thought and directly create life—in one hundred years. Tom Bearden compresses this to ten to twenty years.

In three "Ray of Discovery" tapes, written and produced by Gerry Vassilatos (distributed by Borderland Sciences Research Foundation, Bayside, CA), I see reference to Tesla and radionics research in the first half of this century. This makes me ask,

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just how advanced is civilization? Mr. Vassilatos has compiled an eleven-volume *Vril Compendium* book series, which is spiral-bound and put out by Borderlands. I also refer readers to *Secrets of Cold War Technology* by Vassilatos.

So, I wish to caution everyone not to be in too mad and euphoric a rush to grab the high-tech brass ring of such things as Zero Point Energy. I suggest there are energies in fact as fundamental as Zero Point Energy, but which exist transphysically—more so in terms of formal, efficient, and final causality, to quote Thomism and Thomas Aquinas. These energies are more "informational," and in a way they exist beyond space and time.

Turning again to Sheldrake's classic, *A New Science of Life*. On its back cover it says in review: "Why do many phenomena defy these explanations of conventional biology and physics? For instance, when laboratory rats in one place have learned how to navigate a new maze, why do rats elsewhere seem to learn it more easily? Rupert Sheldrake describes this as 'morphic resonance.' The past forms and behaviors of organisms, he argues, influence organisms in the present through direct connections across space and time. Calling into question many of our fundamental concepts of life and consciousness, Sheldrake reinterprets the regularities of nature as more like habits than immutable laws."

"The first edition of *A New Science of Life* created a furor when it appeared, provoking the outrage of the old-guard scientific community and the approbation of the new. The British journal, *Nature* called it 'the best candidate for burning there has been for many years.'' A lively debate ensued, as researchers devised experiments testing Sheldrakes HYPOTHESIS, INCLUDING SOME INVOLVING MILLIONS OF PEOPLE THROUGH THE MEDIUM OF TELEVISION. These developments are recorded in this revised and expanded edition."

Dr. Sheldrake notes in his book, "At present, the orthodox approach to biology is given by the mechanistic theory of life; living organisms are regarded as physicochemical machines, and all the phenomena of life are considered to be explicable in principle by physics and chemistry." This belief has come about because of the spectacular successes of this interpretation of nature over the last century.

As for my own opinion, I think that the last symphony of science has not been written in our world's department of musicology at the University of Great Unknowns. We need anthologies of readings, patents, and speculative essays. We need a multidisciplinary approach to science by way of think tanks, journals, newsletters, and conferences. Moreover, we need grueling ex-systematic studies of subtle energies in the lab and in the field, as have been conducted by Dr. Glen Rein.

As a creative writer and humble thinker, I wonder if we could build a Robby the Robot as built by Dr. Morbius in *Forbidden Planet*; if we could develop wireless instrumentation panels requiring no direct wiring; if we could construct machines that could project our quasi-immaterial thoughts and images into a holographic image— as Morbius did with his daughter Altaira in the Krell laboratory; if we could learn to project "thought force" and amplify it exponentially; if a scientific team could be assembled to comb the Science Journals and ascertain the possibility of a Krell-like Project Prometheus? Perhaps, but our world still harbors weapons of atomic fire. Until we dismantle our weapons and learn to live in peace, I'm afraid such a thing would be a Doomsday Project.

Forbidden Planet ends with this statement by Commander Adams, after he and Altaira, Dr. Morbius' daughter witness Altair IV blow up after they are one hundred million miles out in space: "Perhaps in a million years, when man has crawled to where the Krell stood in their great moment of triumph and tragedy, your father's name will shine again, like a beacon in the Galaxy, reminding us, after all, that we are not God."

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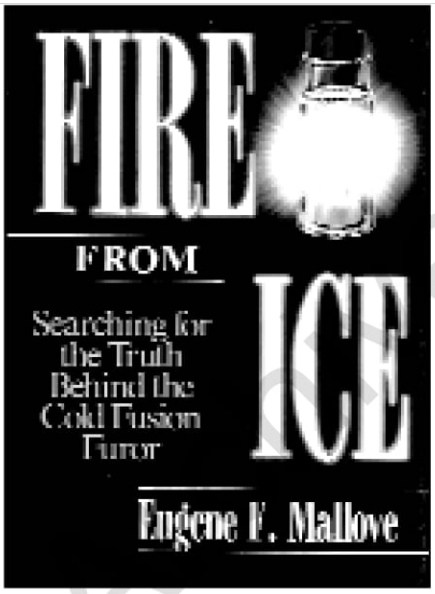

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The Aspden-Adams Electrical Motor-Generator Patent

UK Patent GB 2 282 708 B

Title of Invention
Electrical motor-generator

INT CL[6]; H02K 29/08 23/52 23/66// H02K 1/27

Application No
9320215.8
Date of filing
30.09.1993
Application published
12.04.1995
Patent published
06.11.1996
Domestic classification
(Edition O)
H2A AKC2 AKR1 AK108
AK120 AK121 AK200
AK214R AK216S AK217R
AKS02B AK303R AK800
Documents cited
GB0547668 A
US4972112 A
US4873463 A
Field of search
As for published application 2282708 A viz: UK CL(Edition M) H2A AKRR AKR1 AKR6 AKR9 INT CL[5] H02K 23/62 29/08 29/10 29/12 53/00 57/00 Online databases: WPI, CLAIMS updated as appropriate
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ELECTRICAL MOTOR-GENERATOR

FIELD OF INVENTION

This invention relates to a form of electric motor which serves a generating function in that the machine can act regeneratively to develop output electrical power or can generate mechanical drive torque with unusually high efficiency in relation to electrical power input.

The field of invention is that of switched reluctance motors, meaning machines which have salient poles and operate by virtue of the mutual magnetic attraction and/or repulsion as between magnetized poles. The invention particularly concerns a form of reluctance motor which incorporates permanent magnets to establish magnetic polarization.

BACKGROUND OF THE INVENTION

There have been proposals in the past for machines in which the relative motion of magnets can in some way develop unusually strong force actions which are said to result in more power output than is supplied as electrical input.

By orthodox electrical engineering principles such suggestions have seemed to contradict accepted principles of physics, but it is becoming increasingly evident that conformity with the first law of thermodynamics allows a gain in the electromechanical power balance provided it is matched by a thermal cooling.

In this sense, one needs to extend the physical background of the cooling medium to include, not just the machine structure and the immediate ambient environment, but also the sub-quantum level of what is termed, in modern physics, the zero-point field. This is the field activity of the vacuum medium which exists in the space between atomic nuclei and atomic electrons and is the seat of the action which is that associated with the Planck constant. Energy is constantly being exchanged as between that activity and coextensive matter forms but normally these energy fluctuations preserve, on balance, an equilibrium condition so that this action passes unnoticed at the technology level.

Physicists are becoming more and more aware of the fact that, as with gravitation, so magnetism is a route by which we can gain access to the sea of energy that pervades the vacuum. Historically, the energy balance has been written in mathematical terms by assigning 'negative' potential to gravitation or magnetism. However, this is only a disguised way of saying that the vacuum field, suitably influenced by the gravitating mass of a body in the locality or by magnetism in a ferromagnet has both the capacity and an urge to shed energy.

Now, however, there is growing awareness of the technological energy generating potential of this field background and interest is developing in techniques for 'pumping' the coupling between matter and vacuum field to derive power from that hidden energy source. Such research may establish that this action will draw on the 2. 7K cosmic background temperature of the space medium through which the Earth travels at some 400 km/s. The effect contemplated could well leave a cool 'vapour trail' in space as a machine delivering heat, or delivering a more useful electrical form of energy that will revert to heat, travels with body Earth through that space.

In pure physics terms, relevant background is of recent record in the August 1993 issue of *Physical Review E*, vol. 48, pp. 1562-1565 under the title: 'Extracting energy and heat from the vacuum', authored by D. C. Cole and H. E. Puthoff. Though the connection is not referenced in that paper, one of its author's presented experimental evidence on that theme at an April 1993 conference held in Denver USA. The plasma power generating device discussed at that conference was the subject of U. S . Patent No. 5,018,180, the inventor of record being K. R. Shoulders.

The invention, to be described below, operates by extracting energy from a magnetic system in a motor and the relevant scientific background to this technology can be appreciated from the teachings of E. B. Moullin, a Cambridge Professor of Electrical Engineering who was a President of the Institution of Electrical Engineers in U. K.

That prior art will be described below as part of the explanation of the operation of the invention.

The invention presented here concerns specific structural design features of a machine adapted for robust operation, but these also have novelty and special merit in a functional operation. What is described is quite distinct from prior art proposals, one being a novel kind of motor proposed by Gareth Jones at a 1988 symposium held in Hull, Canada under the auspices of the Planetary Association for Clean Energy. Jones suggested the adaptation of an automobile alternator which generates three-phase a. c . for rectification and use as a power supply for the electrics in the automobile. This alternator has a permanent magnet rotor and Jones suggested that it could be used, with high efficiency gain and torque performance, by operating it as a motor with the three-phase winding circuit excited so as to promote strong repulsion between the magnet poles and the stator poles after the poles

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had come into register. However, the Jones machine is not one exploiting the advantages of the invention to be described, because it is not strictly a reluctance motor having salient poles on both stator and rotor. The stator poles in the Jones machine are formed by the winding configuration in a slotted stator form, the many slots being uniformly distributed around the inner circumference of the stator and not constituting a pole system which lends itself to the magnetic flux actions to be described by reference to the E. B. Moullin experiment.

The Jones machine operates by generating a rotating stator field which, in a sense, pushes the rotor poles forward rather than pulling them in the manner seen in the normal synchronous motor. Accordingly, the Jones machine relies on the electric current excitation of the motor producing a field system which rotates smoothly but has a polarity pattern which is forced by the commutation control to keep behind the rotor poles in asserting a continuous repulsive drive.

Another prior art proposal which is distinguished from this invention is that of one of the applicants, H. Aspden, namely the subject of U.K. Patent No. 2,234,863 (counterpart U.S. Patent Serial No. 4,975,608). Although this latter invention is concerned with extracting energy from the field by the same physical process as the subject invention, the technique for accessing that energy is not optimum in respect of the structure or method used. Whereas in this earlier disclosure, the switching of the reluctance drive excited the poles in their approach phase, the subject invention, in one of its aspects, offers distinct advantages by demagnetization or reversal of magnetization in the pole separation phase of operation.

There are unexpected advantages in the implementation proposed by the subject invention, inasmuch as recent research has confirmed that it requires less input power to switch off the mutual attraction across an air gap between a magnet and an electromagnet than it does to switch it on. Usually, in electromagnetism, a reversal symmetry is expected, arising from conventional teaching of the way forward and back magnetomotive forces govern the resulting flux in a magnetic circuit. This will be further explained after describing the scope of the invention.

BRIEF DESCRIPTION OF THE INVENTION

According to one aspect of the invention, an electrodynamic motor-generator machine comprises a stator configured to provide a set of stator poles, a corresponding set of magnetizing windings mounted on the stator pole set, a rotor having two sections each of which has a set of salient pole pieces, the rotor sections being axially spaced along the axis of rotation of the rotor, rotor magnetization means disposed between the two rotor sections arranged to produce a unidirectional magnetic field which magnetically polarizes the rotor poles, whereby the pole faces of one rotor section all have a north polarity and the pole faces of the other rotor section all have a south polarity and electric circuit connections between an electric current source and the stator magnetizing windings arranged to regulate the operation of the machine by admitting current pulses for a duration determined according to the angular position of the rotor, which pulses have a direction tending to oppose the polarization induced in the stator by the rotor polarization as stator and rotor poles separate from an in-register position, whereby the action of the rotor magnetization means provides a reluctance motor drive force to bring stator and rotor poles into register and the action of the stator magnetization windings opposes the counterpart reluctance braking effect as the poles separate, the machine being characterized in that the stator comprises separate ferromagnetic bridging members mounted parallel with the rotor axis, the ends of which constitute stator poles and the core sections of which provide closure paths operative when the stator and rotor poles are in register to confine magnetic flux developed by the rotor magnetization means to a stator flux path of restricted crosssection disposed antiparallel with the unidirectional magnetic field polarization axis of the rotor magnetizing means.

According to a feature of the invention, the circuit connecting the electric current source and the stator magnetizing windings is designed to deliver current pulses which are of sufficient strength and duration to provide demagnetization of the stator poles as the stator and rotor poles separate from an inregister position.

In this regard it is noted that in order to suppress the reluctance drive torque or brake torque, depending upon whether poles are converging or separating, a certain amount of electrical power must be fed to the magnetizing windings on the stator. In a sense these windings are really 'demagnetizing windings' because the polarity of the circuit connections admit the pulse current in the demagnetizing direction. However, it is more usual to refer to windings on magnetic cores as 'magnetizing windings' even though they can function as primary windings or secondary windings, the former serving the magnetization function with input power and the latter serving a demagnetizing function with return of power.

According to another feature of the invention, the circuit connecting the electric current source and the stator magnetizing windings is designed to deliver current pulses which are of sufficient strength and duration to provide a reversal of magnetic flux direction in the stator poles as the stator and rotor poles separate from an inregister position, whereby to draw on power supplied from the electric current source to provide additional forward drive torque.

According to a further feature of the invention, the electric current source connected to a stator magnetizing winding of a first stator pole comprises, at least partially, the electrical pulses induced in the stator magnetizing winding of a different second stator pole, the stator pole set configuration in relation to the rotor pole set configuration being such that the first stator pole is coming into register with a rotor pole as the second stator pole separates from its in-register position with a rotor pole.

This means that the magnetizing windings of two stator poles are connected so that both serve a 'demagnetizing' function, one in resisting the magnetic action of the mutual attraction in pulling poles into register, an action which develops a current pulse output and one in absorbing this current pulse, again by resisting the magnetic inter-pole action to demagnetize the stator pole as its associated rotor pole separates.

In order to facilitate the function governed by this circuit connection between stator magnetizing windings, a phase difference is needed and this is introduced by designing the machine to have a different number of poles in a set of stator poles from the number of rotor poles in each rotor section. Together with the dual rotor section feature, this has the additional merit of assuring a smoother torque action and reducing magnetic flux fluctuations and leakage effects which contribute substantially to machine efficiency.

Thus, according to another feature of the invention, the stator configuration provides pole pieces which are common to both rotor sections in the sense that when stator and rotor poles are in-register the stator pole pieces constitute bridging members for magnetic flux closure in a magnetic circuit including that of the rotor magnetization means disposed between the two rotor sections.

Preferably, the number of poles in a set of stator poles and the number of rotor poles in each section do not share a common integer factor, the number of rotor poles in one rotor section is the same as that in the other rotor section and the number of poles in a stator set and the number of poles in a rotor section differs by one, with the pole faces being of sufficient angular width to assure that the magnetic flux produced by the rotor magnetization means can find a circuital magnetic flux closure route through the bridging path of a stator pole and through corresponding rotor poles for any angular position of the rotor.

It is also preferable from a design viewpoint for the stator pole faces of this invention to have an angular width that is no

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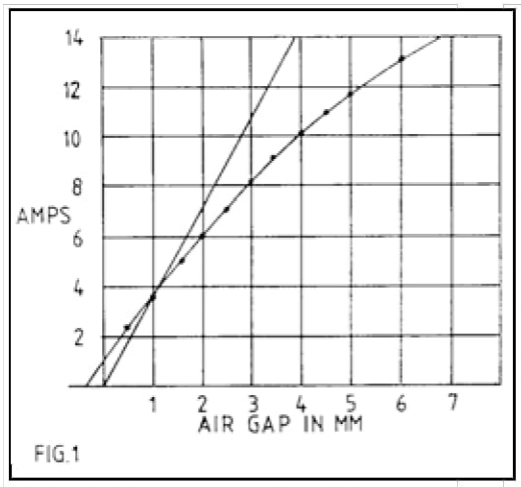


FIG.1

greater than half the angular width of a rotor pole and for the rotor sections to comprise circular steel laminations in which the rotor poles are formed as large teeth at the perimeter with the rotor magnetization means comprising a magnetic core structure the end faces of which abut two assemblies of such laminations forming the two rotor sections.

According to a further feature of the invention, the rotor magnetization means comprises at least one permanent magnet located with its polarization axis parallel with the rotor axis. The motorgenerator may include an apertured metal disc that is of a nonmagnetizable substance mounted on a rotor shaft and positioned intermediate the two rotor sections, each aperture providing location for a permanent magnet, whereby the centrifugal forces acting on the permanent magnet as the rotor rotates are absorbed by the stresses set up in the disc. Also, the rotor may be mounted on a shaft that is of a non-magnetizable substance, whereby to minimize magnetic leakage from the rotor magnetizing means through that shaft.

According to another aspect of the invention, an electrodynamic motor-generator machine comprises a stator configured to provide a set of stator poles, a corresponding set of magnetizing windings mounted on the stator pole set, a rotor having two sections each of which has a set of salient pole pieces, the rotor sections being axially spaced along the axis of rotation of the rotor, rotor magnetization means incorporated in the rotor structure and arranged to polarize the rotor poles, whereby the pole faces of one rotor section all have a north polarity and the pole faces of the other rotor section all have a south polarity and electric circuit connections between an electric current source and the stator magnetizing windings arranged to regulate the operation of the machine by admitting current pulses for a duration determined according to the angular position of the rotor, which pulses have a direction tending to oppose the polarization induced in the stator by the rotor polarization as stator and rotor poles separate from an in-register position, whereby the action of the rotor magnetization means provides a reluctance motor drive force to bring stator and rotor poles into register and the action of the stator magnetization windings opposes the counterpart reluctance braking effect as the poles separate, the machine being characterized in that the stator comprises separate ferromagnetic bridging members mounted parallel with the rotor axis, the ends of which constitute stator poles and the core sections of which provide closure paths operative when the stator and rotor poles are in register to confine magnetic flux developed by the rotor magnetization means to a stator flux path of restricted cross-section disposed antiparallel with the unidirectional magnetic field polarization axis of the rotor magnetizing means.

According to a feature of this latter aspect of the invention, the electric current source connected to a stator magnetizing winding of a first stator pole comprises, at least partially, the electrical pulses induced in the stator magnetizing winding of a different second stator pole, the stator pole set configuration in relation to the rotor pole set configuration being such that the first stator pole is coming into register with a rotor pole as the second stator pole separates from its in-register position with a rotor pole.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 presents magnetic core test data showing how the volt-amp reactance power required to set up a constant magnetic flux action in an air gap, as assured by constant a.c. voltage excitation of a magnetizing winding, falls short of the associated power of the potential implicit in the force action across that air gap.

Fig. 2 depicts the test structure to which Fig. 1 data applies.

Fig. 3 depicts the magnetization action at work in causing magnetic flux to traverse an airgap and turn a corner in a circuit through a magnetic core.

Fig. 4 shows the configuration of a test device used to prove the operating principles of the invention described.

Fig. 5 in its several illustrations depicts the progressive rotor pole to stator pole relationship as a rotor turns through a range of angular positions in a preferred embodiment of a machine according to the invention.

Fig. 6 shows the form of a disc member which provides location for four permanent magnets in the machine described.

Fig. 7 shows a cross-section of the magnetic circuit structure of a machine embodying the invention.

Fig. 8 shows a six stator pole configuration with a seven pole rotor and depicts a schematic series connected linking of the magnetizing windings of diametrically opposite stator poles.

DETAILED DESCRIPTION OF THE INVENTION

The fact that one can extract energy from the source which powers the intrinsic ferromagnetic state is not explicitly evident from existing textbooks, but it is implicit and, indeed, does become explicit once pointed out, in one textbook authored by E. B. Moullin.

His book 'The Principles of Electromagnetism' published by Claren-don Press, Oxford (3rd Edition, 1955) describes on pages 168-174 an experiment concerned with the effect of air gaps between poles in a magnetic circuit. The data obtained are reproduced in Fig. 1, where Professor Moullin shows a curve representing a. c . current input for different air gaps, given that the voltage supplied is constant. In the same figure, Moullin presents the theoretical current that would need to be applied to sustain the same voltage, and so the related pole forces across the air gap, assuming (a) no flux leakage and (b) that there is complete equality between inductive energy input and the mechanical energy potential for the magnetization that is established in the air gap in a quarter-cycle period at the a.c. power excitation frequency.

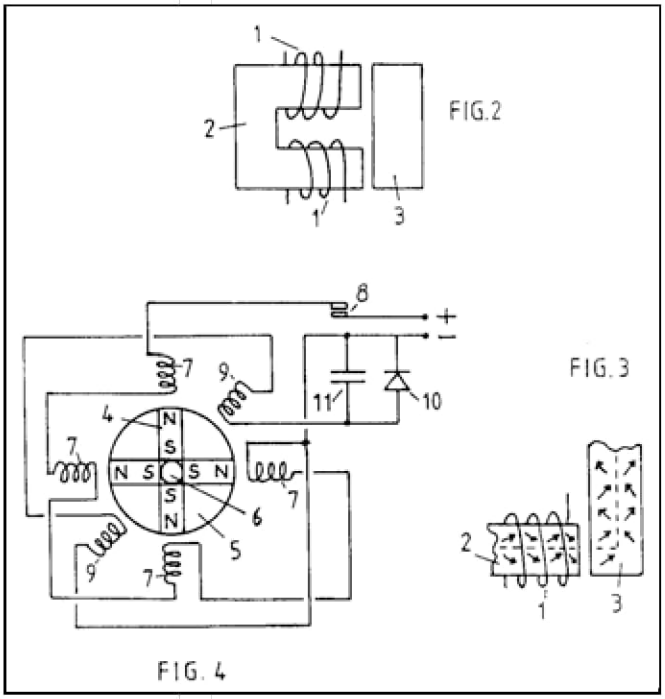
The data show that, even though the level of magnetic polarization is well below the saturation value, being confined to a range that is regarded as the linear permeability range in transformer design, there is a clear drop-off of current, and so the volt-amp reactive power input needed, as current increases, compared with that predicted by the mechanical potential built up in the air gaps.

Unless leakage flux is excessive, here was clear evidence of anomalous energy activity.

Moullin discusses the leakage flux inferred by this experiment but points out that there is considerable mystery in why the effect of a small gap, which should certainly not result in much flux leakage in the gap region, nevertheless has an enormous effect in causing what has to be substantial leakage in the light of the energy discrepancy.

Moullin did not contemplate that energy had been fed in from the zero-point field system and so he left the issue with the statement that it was virtually impossible to predict leakage flux by calculation.

He was, of course, aware of magnetic domain structure and his argument was that the leakage flux problem was connected with what he termed a 'yawing' action of the flux as it passes around the magnetic circuit. Normally, provided the level of polarization is below the knee of the B-H curve, which occurs at about 70% of saturation in iron cores of general crystal composition, it requires very little magnetizing field to change the magnetic flux density. This is assuming that every effort is made to avoid air gaps. The action involves domain wall movements so that the magnetic



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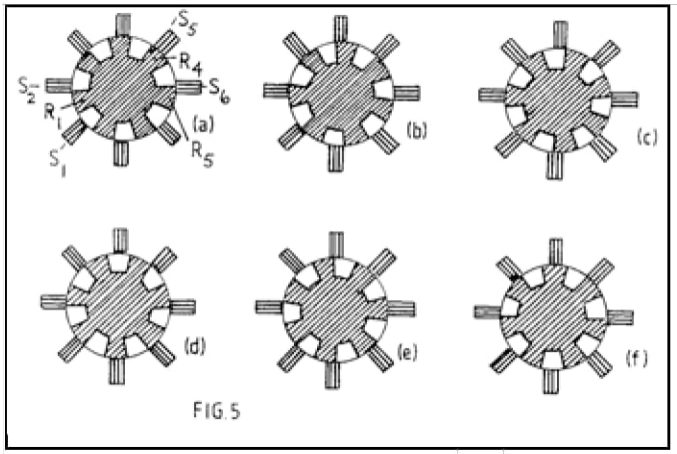


FIG.5

states of adjacent domains switch to different crystal axes of easy magnetization and this involves very little energy change.

However, if there is an air gap ahead in the flux circuit and the magnetizing winding is not sitting on that air gap, the iron core itself has to be the seat of a progressive field source linking the winding and the gap. It can only serve in that sense by virtue of the lines of flux in the domains being forced to rotate somewhat from the preferred easy axes of magnetization, with the help of the boundary surfaces around the whole core. This action means that, forcibly, and consequential upon the existence of the air gap, the flux must be carried through the core by that 'yawing' action. It means that substantial energy is needed to force the establishment of those fields within the iron core. More important, however, from the point of view of this invention, it means that the intrinsic magnetic polarization effects in adjacent magnetic domains in the iron cease to be mutually parallel or orthogonal so as to stay directed along axes of easy magnetization. Then, in effect, the magnetizing action is not just that of the magnetizing winding wrapped around the core but becomes also that of adjacent ferromagnetic polarization as the latter act in concert as vacuum-energy powered solenoids and are deflected into one another to develop the additional forward magnetomotive forces.

The consequences of this are that the intrinsic ferromagnetic power source with its thermodynamic ordering action contributes to doing work in building up forces across the air gap. The task, in technological terms, is then to harness that energy as the gap is closed, as by poles coming together in a reluctance motor, and avoid returning that energy as the poles separate, this being possible if the controlling source of primary magnetization is well removed from the pole gap and the demagnetization occurs when the poles are at the closest position.

This energy situation is evident in the Moullin data, because the constant a. c. voltage implies a constant flux amplitude across the air gap if there is no flux leakage in the gap region. A constant flux amplitude implies a constant force between the poles and so the gap width in relation to this force is a measure of the mechanical energy potential of the air gap. The reactive volt-amp power assessment over the quarter-cycle period representing the polarization demand can then be compared with the mechanical energy so made available. As already stated, this is how Moullin deduced the theoretical current curve. In fact, as his data show, he needed less current than the mechanical energy suggested and so he had in his experiment evidence of the vacuum energy source that passed unnoticed and is only now revealing itself in machines that can serve our energy needs.

In the research leading to this patent application the Moullin experiment has been repeated to verify a condition where a single magnetizing winding serves three air gaps. The Moullin test configuration is shown in Fig. 2, but in repeating the experiment in the research leading to this invention, a search coil was mounted on the bridging member and this was used to compare the ratio of the voltage applied to the magnetizing winding and that induced in the search coil. The same falloff feature in current demand was observed, and there was clear evidence of substantial excess energy in the air gap. This was in addition to the inductive energy that necessarily had to be locked into the magnetic core to sustain the 'yawing' action of the magnetic flux already mentioned .

It is therefore emphasized that, in priming the flux 'yawing' action, energy is stored inductively in the magnetic core, even though this has been deemed to be the energy of flux leakage outside the core. The air gap energy is also induction energy. Both energies are returned to the source winding when the system is demagnetized, given a fixed air gap. If, however, the air gap closes after or during magnetization, much of that inductive energy goes into the mechanical work output. Note then that the energy released as mechanical work is not just that stored in the air gap but is that stored in sustaining the 'yaw'. Here, then is reason to expect an even stronger contribution to the dynamic machine performance, one that was not embraced by the calculation of the steadystate situation.

Given the above explanation of the energy source, the structural features which are the subject of this invention will now be described.

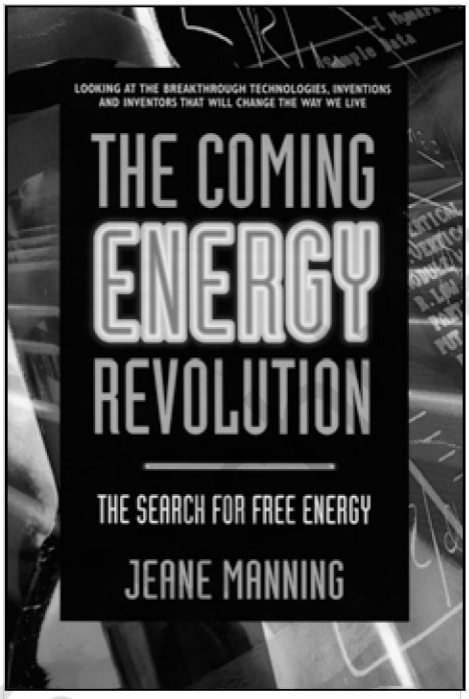
The 'yawing' action is depicted in Fig. 3, which depicts how magnetic flux navigates a right-angled bend in a magnetic core upon passage through an air gap. By over-simplification it is assumed that the core has a crystal structure that has a preferred axis of magnetization along the broken line path. With no air gap, the current needed by a magnetizing winding has only to provide enough magnetomotive force to overcome the effects of non-magnetic inclusions and impurities in the core substance and very high magnetic permeabilities can apply. However, as soon as the air gap develops, this core substance has to find a way of setting up magnetomotive force in regions extending away from the locality of the magnetizing winding. It cannot do this unless its effect is so powerful that the magnetic flux throughout the magnetic circuit through the core substance is everywhere deflected from alignment with a preferred easy axis of magnetization. Hence the flux vectors depicted by the arrows move out of alignment with the broken line shown.

There is a 'knock-on' effect progressing all the way around the core from the seat of the magnetizing winding and, as already stated, this harnesses the intrinsic ferromagnetic power that, in a system with no air gap, could only be affected by magnetization above the knee of the B-H curve. Magnetic flux rotation occurs above that knee, whereas in an ideal core the magnetism develops with very high permeability over a range up to that knee, because it needs very little power to displace a magnetic domain wall sideways and promote a 90° or a 180° flux reversal. Indeed, one can have a magnetic permeability of 10,000 below the knee and 100 above the knee, the latter reducing progressively until the substance saturates magnetically.

In the situation depicted in Figs 2 or 3 the field strength developed by the magnetizing windings 1 on magnetic core 2 has to be higher, the greater the air gap, in order to achieve the same amount of magnetization as measured by the voltage induced in a winding (not shown) on the bridging member 3. However, by virtue of that air gap there is potential for harnessing energy supplied to that air gap by the intrinsic zero-point field that accounts for the magnetic permeability being over unity and here one can contemplate very substantial excess energy potential, given incorporation in a machine design which departs from convention.

One of the applicants has built an operative test machine which is configured as depicted schematically in Fig. 4. The machine has been proved to deliver substantially more mechanical power output than is supplied as electrical input, as much as a ratio of 7:1 in one version, and it can act regeneratively to produce electrical power.

What is shown in Fig. 4 is a simple model designed to demonstrate the principle of operation. It comprises a rotor in which four permanent magnets 4 are arrayed to form four poles. The magnets are bonded into four sectors of a nonmagnetic disc 5 using a high density polyurethane foam filler and the composite disc is then



... *THE REVOLUTION IS COMING!*

The Coming Energy Revolution

by Jeane Manning

1996, published by Avery Publishing Group, Garden City Park, New York
230 pages, illus., resource list, glossary, indexed, ISBN 0-89529-713-2.

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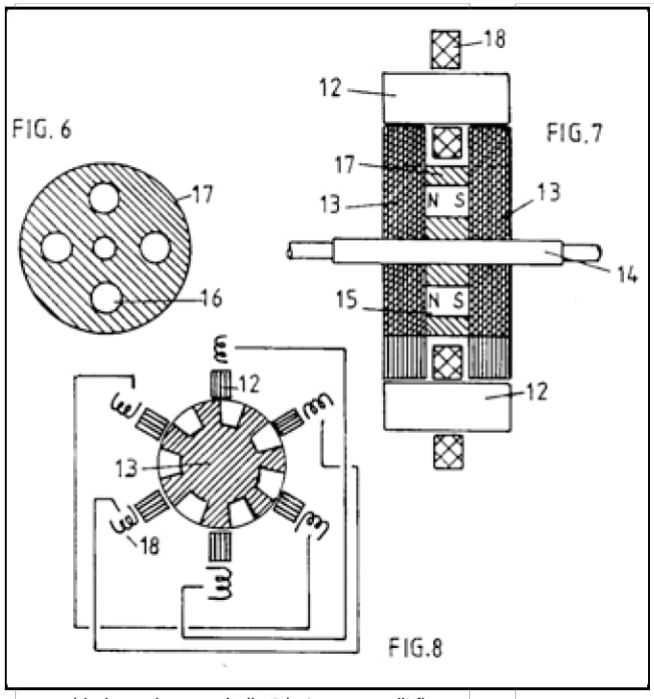

assembled on a brass spindle 6 between a split flange coupling. Not shown in the figure is the structure holding the spindle vertically in bearings or the star wheel commutator assembly attached to the upper shaft of the spindle.

Note that the magnets present north poles at the perimeter of the rotor disc and that the south poles are held together by being firmly set in the bonding material.

A series of four stator poles were formed using magnetic cores from standard electromagnetic relays are were positioned around the rotor disc as shown. The magnetizing windings 7 on these cores are shown to be connected in series and powered through commutator contacts 8 by a d. c. power supply. Two further stator cores formed by similar electromagnetic relay components are depicted by their windings 9 in the intermediate angle positions shown and these are connected in series and connected to a rectifier 10 bridged by a capacitor 11.

The rotor spindle 6 is coupled with a mechanical drive (not shown) which harnesses the torque developed by the motor thus formed and serves as a means for measuring output mechanical power delivered by the machine.

In operation, assuming that the rotor poles are held initially offregister with the corresponding stator poles and the hold is then released, the strong magnetic field action of the permanent magnets will turn the rotor to bring the stator and rotor poles into register. A permanent magnet has a strong attraction for soft iron and so this initial impulse of rotation is powered by the potential energy of the magnets.

Now, with the rotor acting as a flywheel and having inertia it will have a tendency to over-shoot the in-register pole position and that will involve a reverse attraction with the result that the rotor will oscillate until damping action brings it to rest. However, if the contacts of the commutating switch are closed as the poles come first into register, the magnetizing windings 7 will receive a current pulse which, assuming the windings are connected in the right sense, tends to demagnetize the four stator cores. This means that, as the stator and rotor poles separate, the reverse attraction by the magnets is eliminated. Indeed, if the demagnetizing current pulses supplied to the windings 4 are strong enough, the stator poles can reverse polarity and that results in a repulsion giving forward drive to the separating rotor poles.

The net result of this action is that the rotor will continue rotating until it passes the dead centre angular position which allows the rotor to be attracted in the forward direction by the stator poles 90° forward of those acting originally.

The commutating switch 8 needs only to be closed for a limited period of angular travel following the top dead centre in-register position of the stator and rotor poles. The power supplied through that switch by those pulses will cause the rotor to continue rotating and high speeds will be achieved as the machine develops its full motor function.

Tests on such a machine have shown that more mechanical power can be delivered than is supplied electrically by the source powering the action through the commutating switch. The reason for this is that, whereas the energy in the air gap between rotor and stator poles which is tapped mechanically as the poles come into register is provided by the intrinsic power of the ferromagnet, a demagnetizing winding on the part of the core system coupled across that air gap needs very little power to eliminate the mechanical force acting across that air gap. Imagine such a winding on the bridging member shown in Fig. 2. The action of current in that winding, which sits astride the 'yawing' flux in that bridging member well removed from the source action of the magnetizing windings 1, is placed to be extremely effective in resisting the magnetizing influence communicated from a distance. Hence very little power is needed to overcome the magnetic coupling transmitted across the air gap.

Although the mutual inductance between two spaced-apart magnetizing windings has a reciprocal action, regardless of which winding is primary and which is secondary, the action in the particular machine situation being described involves the 'solenoidal' contribution represented by the 'yawing' ferromagnetic flux action. The latter is not reciprocal inasmuch as the flux 'yaw' depends on the geometry of the system. A magnetizing winding directing flux directly across an air gap has a different influence on the action in the ferromagnetic core from one directing flux lateral to the air gap and there is no reciprocity in this action .

In any event, the facts of experiment do reveal that, owing to a significant discrepancy in such mutual interaction, more mechanical power is fed into the rotor than is supplied as input from the electrical source.

This has been further demonstrated by using the two stator windings 9 to respond in a generator sense to the passage of the rotor poles. An electrical pulse is induced in each winding by the passage of a rotor pole and this is powered by the inertia of the rotor disc 5. By connecting the power so generated to charge the capacitor 11 the d.c. power supply can be augmented to enhance the efficiency even further. Indeed, the machine is able to demonstrate the excess power delivery from the ferromagnetic system by virtue of electrical power generation charging a battery at a greater rate than a supply battery is discharged.

This invention is concerned with a practical embodiment of the motorgenerator principles just described and aims, in its preferred aspect, to provide a robust and reliable machine in which the tooth stresses in the rotor poles, which are fluctuating stresses communicating high reluctance drive torque, are not absorbed by a ceramic permanent magnet liable to rupture owing to its brittle composition.

Another object is to provide a structure which can be dismantled and reassembled easily to replace the permanent magnets, but an even more important object is that of minimizing the stray leakage flux oscillations from the powerful permanent magnets. Their rotation in the device depicted in Fig. 4 would cause excessive eddy-current induction in nearby metal, including that of the machine itself, and such effects are minimized if the flux changes are confined to paths through steel laminations and if the source flux from the magnets has a symmetry or near symmetry about the axis of rotation.

Thus, the ideal design with this in mind is one where the permanent magnet is a hollow cylinder located on a non-magnetic rotor shaft, but, though that structure is within the scope of this invention, the machine described will utilize several separate permanent magnets approximating, in function, such a cylindrical configuration.

Referring to Fig. 4, it will further be noted that the magnetic flux emerging from the north poles will have to find its way along leakage paths through air to reenter the south poles. For periods in each cycle of machine operation the flux will be attracted through the stator cores, but the passage through air is essential and so the power of the magnets is not used to full advantage and there are those unwanted eddy-current effects .

To overcome this problem the invention provides for two separate rotor sections and the stator poles become bridging members, which with optimum design, allow the flux from the magnets to find a route around a magnetic circuit with minimal leakage through air as the flux is directed through one or other pairs of air gaps where the torque action is developed.

Reference is now made to Fig. 5 and the sequence of rotor positions shown. Note that the stator pole width can be significantly smaller that that of the rotor poles. Indeed, for operation using the principles of this invention, it is advantageous for the stator to have a much smaller pole width so as to concentrate the effective pole region. A stator pole width of half that of the rotor is appropriate but it may be even smaller and this has the secondary advantage of requiring smaller magnetizing windings and so saving on the loss associated with the current circuit.

The stator has eight pole pieces formed as bridging members 12, more clearly represented in Fig. 7, which shows a sectional side view through two rotor sections 13 axially spaced on a rotor shaft 14. There are four permanent magnets 15 positioned between these rotor sections and located in apertures 16 in a disc 17 of a non-magnetic substance of high tensile strength, the latter being shown in Fig. 6. The rotor sections are formed from disc laminations of electrical steel which has seven large teeth, the salient poles. Magnetizing windings 18 mounted on the bridging members 12 constitute the system governing the action of the motor-generator being described.

The control circuitry is not described as design of such circuitry involves ordinary skill possessed by those involved in the electrical engineering art.

It suffices, therefore, to describe the merits of the structural design configuration of the core elements of the machine. These concern principally the magnetic action and, as can be imagined from Fig. 7, the magnetic flux from the magnets enters the rotor laminations by traversing the planar faces of the laminations and being deflected into the plane of the laminations to pass through one or other of the stator pole bridging members, returning by a similar route through the other rotor.

By using eight stator poles and seven rotor poles, the latter having a pole width equal to half the pole pitch in an angular sense, it will be seen from Fig. 5, that there is always a flux passage across the small air gap between stator and rotor poles. However, as one pole combination is in-register the diametrically-opposed pole combinations are out-of register .

As described by reference to Fig. 4 the operation of the machine involves allowing the magnet to pull stator and rotor poles into register and then, as they separate, pulsing the winding on the relevant stator member to demagnetize that member. In the Fig. 4 system, all the stator magnetizing windings were pulsed together, which is not an optimum way in which to drive a multi-pole machine. In the machine having the pole structure with one less rotor pole than stator poles (or an equivalent design in which there is one less stator pole than rotor poles) this pulsing action can be distributed in its demand on the power supply, and though this makes the commutation switch circuit more expensive the resulting benefit outweighs that cost.

However, there is a feature of this invention by which that problem can be alleviated if not eliminated.

Suppose that the rotor has the position shown in Fig. 5(a) with the rotor pole denoted R_1 midway between stator poles S_1 and S_2 and imagine that this is attracted towards the in-register position with stator pole S_2. Upon reaching that in-register position, as shown in Fig. 5 (c), suppose that the magnetizing winding of stator pole S2 is excited by a current pulse which is sustained until the rotor reaches the Fig. 5(e) position. The combination of these two actions will have imparted a forward drive impulse powered by the permanent magnet in the rotor structure and the current pulse which suppresses braking action will have drawn a smaller amount of energy from the electrical power source that

supplies it. This is the same process as was described by reference to Fig. 4.

However, now consider the events occurring in the rotor action diametrically opposite that just described. In the Fig 5(a) position rotor pole R_4 has come fully into register with stator pole S_5 and so stator pole S_5 is ready to be demagnetized. However, the magnetic coupling between the rotor and stator poles is then at its strongest. Note, however, that in that Fig. 5(a) position R_5 is beginning its separation from stator pole S_6 and the magnetizing winding of stator pole S_6 must then begin draw power to initiate demagnetization. During that following period of pole separation the power from the magnet is pulling R_1 and S_2 together with much more action than is needed to generate that current pulse needed to demagnetize S_6. It follows, therefore, that, based on the research findings of the regenerative excitation in the test system of Fig. 4, the series connection of the magnetizing windings on stators S_2 and S_6 will, without needing any commutative switching, provide the regenerative power needed for machine operation.

The complementary action of the two magnetizing windings during the pole closure and pole separation allows the construction of a machine which, given that the zero-point vacuum energy powering the ferromagnet is feeding input power, will run on that source of energy and thereby cool the sustaining field system.

There are various design options in implementing what has just been proposed. Much depends upon the intended use of the machine. If it is intended to deliver mechanical power output the regenerative electrical power action can all be used to power the demagnetization with any surplus contributing to a stronger drive torque by reversing the polarity of the stator poles during pole separation.

If the object is to generate electricity by operating in generator mode then one could design a machine having additional windings on the stator for delivering electrical power output. However, it seems preferable to regard the machine as a motor and maximize its efficiency in that capacity whilst using a mechanical coupling to an alternator of conventional design for the electrical power generation function.

In the latter case it would still seem preferable to use the self-excitation feature already described to reduce commutation switching problems.

The question of providing for machine start-up can be addressed by using a separate starter motor powered from an external supply or by providing for current pulsing limited to, say, two stator poles. Thus, for example, with the eight stator pole configuration, the crossconnected magnetizing windings could be be limited to three stator pairs, with two stator magnetizing windings left free for connection to a pulsed external supply source.

If the latter feature were not required, then the stator magnetizing windings would all be connected in pairs on a truly diametrically opposite basis. Thus Fig. 8 shows a rotor-stator configuration having six stator poles interacting with seven rotor poles and stator magnetizing windings linked together in pairs.

The invention, therefore, offers a wide range of implementation possibilities, which, in the light of this disclosure will become obvious to persons skilled in the electrical engineering art, all based, however, on the essential but simple principle that a rotor has a set of poles of common polarity which are attracted into register with a set of stator poles that are suppressed or reversed in polarity magnetically during pole separation. The invention, however, also offers the important feature of minimizing commutation and providing further for a magnetic flux closure that minimizes the leakage flux and fluctuations of leakage flux and so contributes to efficiency and high torque performance as well as durability and reliability of a machine incorporating the invention.

It is noted that although a machine has been described which uses two rotor sections it is possible to build a composite version of the machine having several rotor sections. In the eventuality that the invention finds use in very large motor-generator machines the problem of providing very large magnets can be overcome by a design in which numerous small magnets are assembled. The structural concept described by reference to Fig. 6 in providing locating apertures to house the magnets makes this proposal highly feasible. Furthermore, it is possible to replace the magnets by a steel cylinder and provide a solenoid as part of the stator structure and located between the rotor sections. This would set up an axial magnetic field magnetizing the steel cylinder and so polarizing the rotor. However, the power supplied to that solenoid would detract from the power generated and so such a machine would not be as effective as the use of permanent magnets such as are now available. Nevertheless, should one see significant progress in the development of warm superconductor materials, it may become feasible to harness the self-generating motor-generator features of the invention, with its selfcooling properties, by operating the device in an enclosure at low temperatures and replacing the magnets by a superconductive statorsupported solenoid.

CLAIMS

1 .

An electrodynamic motor-generator machine comprising a stator configured to provide a set of stator poles, a corresponding set of magnetizing windings mounted on the stator pole set, a rotor having two sections each of which has a set of salient pole pieces, the rotor sections being axially spaced along the axis of rotation of the rotor, rotor magnetization means disposed between the two rotor sections arranged to produce a unidirectional magnetic field which magnetically polarizes the rotor poles, whereby the pole faces of one rotor section all have a north polarity and the pole faces of the other rotor section all have a south polarity and electric circuit connections between an electric current source and the stator magnetizing windings arranged to regulate the operation of the machine by admitting current pulses for a duration determined according to the angular position of the rotor, which pulses have a direction tending to oppose the polarization induced in the stator by the rotor polarization as stator and rotor poles separate from an inregister position, whereby the action of the rotor magnetization means provides a reluctance motor drive force to bring stator and rotor poles into register and the action of the stator magnetization windings opposes the counterpart reluctance braking effect as the poles separate, the machine being characterized in that the stator comprises separate ferromagnetic bridging members mounted parallel with the rotor axis, the ends of which constitute stator poles and the core sections of which provide closure paths operative when the stator and rotor poles are in register to confine magnetic flux developed by the rotor magnetization means to a stator flux path of restricted cross-section disposed antiparallel with the unidirectional magnetic field polarization axis of the rotor magnetizing means.

2. A motor-generator according to claim 1, wherein the circuit connecting the electric current source and the stator magnetizing windings is designed to deliver current pulses which are of sufficient strength and duration to provide demagnetization of the stator poles as the stator and rotor poles separate from an inregister position.

3. A motor-generator according to claim 1, wherein the circuit connecting the electric current source and the stator magnetizing windings is designed to deliver current pulses which are of sufficient strength and duration to provide a reversal of magnetic flux direction in the stator poles as the stator and rotor poles separate from an in-register position, whereby to draw on power supplied from the electric current source to provide additional forward drive torque.

4. A motorgenerator according to claim 1, wherein the electric current source connected to a stator magnetizing winding of a first stator pole comprises, at least partially, the electrical pulses induced in the stator magnetizing winding of a different second stator pole, the stator pole set configuration in relation to the rotor pole set configuration being such that the first stator pole is coming into register with a rotor pole as the second stator pole separates from its in-register position with a rotor pole .

5. A motor-generator according to claim 1, wherein the number of poles in a set of stator poles is different from the number of rotor poles in each rotor section.

6. A motor-generator according to claim 1, wherein the stator configuration provides pole pieces which are common to both rotor sections in the sense that when stator and rotor poles are in-register the stator pole pieces constitute bridging members for magnetic flux closure in a magnetic circuit including that of the rotor magnetization means disposed between the two rotor sections.

7. A motor-generator according to claim 6, wherein the number of poles in a set of stator poles and the number of rotor poles in each section do not share a common integer factor and the number of rotor poles in one rotor section is the same as that in the other rotor section.

8. A motor-generator according to claim 7, wherein the number of poles in a stator set and the number of poles in a rotor section differs by one and the pole faces are of sufficient angular width to assure that the magnetic flux produced by the rotor magnetization means can find a circuital magnetic flux closure route through the bridging path of a stator pole and through corresponding rotor poles for any angular position of the rotor.

9. A motor-generator according to claim 8, wherein each rotor section comprises seven poles.

10. A motor-generator according to claim 7, wherein there are N rotor poles in each rotor section and each has an angular width that is 180/N degree of angle.

11. A motor-generator according to claim 7, wherein the stator pole faces have an angular width that is no greater than half the angular width of a rotor pole.

12. A motor-generator according to claim 1, wherein the rotor sections comprise circular steel laminations in which the rotor poles are formed as large teeth at the perimeter, and the rotor magnetization means comprise a magnetic core structure the end faces of which abut two assemblies of such laminations forming the two rotor sections.

13. A motor-generator according to claim 1 in which the rotor magnetization means comprises at least one permanent magnet located with i its polarization axis parallel with the rotor axis.

14. A motor-generator according to claim 13, wherein an apertured metal disc that is of a non-magnetizable substance is mounted on a rotor shaft and positioned intermediate the two rotor sections and each aperture provides location for a permanent magnet, whereby the centrifugal forces acting on the permanent magnet as the rotor rotates are absorbed by the stresses set up in the disc.

15. A motor-generator according to claim 1, having a rotor mounted on a shaft that is of a non-magnetizable substance, whereby to minimize magnetic leakage from the rotor magnetizing means.

16. An electrodynamic motor-generator machine comprising a stator configured to provide a set of stator poles, a corresponding set of magnetizing windings mounted on the stator pole set, a rotor having two sections each of which has a set of salient pole pieces, the rotor sections being axially spaced along the axis of rotation of the rotor, rotor magnetization means incorporated in the rotor structure and arranged to polarize the rotor poles, whereby the pole faces of one rotor section all have a north polarity and the pole faces of the other rotor section all have a south polarity and electric circuit connections between an electric current source and the stator magnetizing windings arranged to regulate the operation of the machine by admitting current pulses for a duration determined according to the angular position of the rotor, which pulses have a direction tending to oppose the polarization induced in the stator by the rotor polarization as stator and rotor poles separate from an inregister position, whereby the action of the rotor magnetization means provides a reluctance motor drive force to bring stator and rotor poles into register and the action of the stator magnetization windings opposes the counterpart reluctance braking effect as the poles separate, the machine being characterized in that the stator comprises separate ferromagnetic bridging members mounted parallel with the rotor axis, the ends of which constitute stator poles and the core sections of which provide closure paths operative when the stator and rotor poles are in register to confine magnetic flux developed by the rotor magnetization means to a stator flux path of restricted crosssection disposed antiparallel with the unidirectional magnetic field polarization axis of the rotor magnetizing means.

17. A motor-generator according to claim 16, wherein the electric current source connected to a stator magnetizing winding of a first stator pole comprises, at least partially, the electrical pulses induced in the stator magnetizing winding of a different second stator pole, the stator pole set configuration in relation to the rotor pole set configuration being such that the first stator pole is coming into register with a rotor pole as the second stator pole separates from its in-register position with a rotor pole .

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Gentlemen, Start Your Bubbles

by David Moon

Could the title of this article one day be the call that goes out to the race drivers at the start of the Indianapolis 500? Race cars powered by sonoluminescence? If you can envision cold fusion automobiles, then the answer may be "Yes." And pit stops will only be for changing tires. No re-fueling necessary.

Sonoluminescence and cold fusion have been on a collision course for several years. This is due in large part to the efforts of Roger Stringham and Russ George at E-Quest Sciences in Palo Alto, California. Their method of acoustic energy (ultrasound) applied to heavy water with palladium or titanium metal has "driven" the skeptics mad. The demanded helium-4 showed up, and the race was on.

The precedence of E-Quest's sonofusion is the pure form of sonoluminescence (SL) itself. The pumping of high frequency sound waves (20,000 cycles or more per second) through fluids such as water to generate cavitation bubbles that rapidly expand and contract at the applied frequency and then emit flashes of blue light has been known since about 1934. But just how sound energy is magnified a trillion times to cause bursts of blue light is a question that has generated more intense research in the last few years. Noted researchers include Lawrence Crum and Ronald Roy (University of Washington in Seattle), Kenneth Suslick (University of Illinois), Anthony Atchley and Felipe Gaitan (Naval Postgraduate School in Monterey, California), Michael Moran and William Moss (Lawrence Livermore National Laboratory) and Seth Putterman, Robert Hiller, Keith Weninger and Bradley Barber (University of California at Los Angeles) [1,2].

After interviewing Drs. Putterman and Crum in October 1991, *21st Century Science and Technology* editor Carol White reported that scientists do not all agree about possible mechanisms at work to convert sound into light energy [1]. For some, the standard thermodynamic model — which says that a collapsing bubble, through adiabatic compression, becomes hotter than the surface of the Sun, or "blue hot" — is inadequate because of the time scale needed for thermal processes. This scale is on the order of microseconds for a collapsed bubble of a few microns in size, according to Dr. Putterman. It was Putterman and Barber who were able to measure the time duration (flash width) of a single burst of light in a solution of 25 percent glycerin in water. The duration is only about 50 picoseconds. Thus for Dr. Putterman, a "mechanical - optics" or "acousto-optics" mechanism must be at work [1].

Although Dr. Putterman and some others cannot accept the direct conversion of heat to light in the collapsed bubbles, scientists do predict that a tremendous focusing of energy — creating high pressures and temperatures — does occur in these minute bubbles. Perhaps for a time period of a few nanoseconds a plasma is created. This plasma might quickly form a vortex of spiraling strings or chains of protons that can oscillate collectively, if only briefly, in and out of the bubble wall. (Although the cavitation bubble is an air bubble, it will contain water vapor molecules which release protons when the plasma eventually forms.) When the protons invade the atoms in the bubble wall, such as oxygen or nitrogen, they would, in this hypothesis, interact in ways that allow for nuclear reactions. So, pure SL is predicted to involve a nuclear effect at some level.

Chain Reaction

A theory of cold fusion called "Mechanisms of a Disobedient Science" [3] uses as its model the formation of long trains (or chains) of protons or deuterons on the surface layers of the host lattice. These long trains, when sufficiently formed, are able to collect their kinetic energy into a wave pulse which then can propel the protons into the volume of a metal atom at a crystal barrier such as a grain boundary. At different regions within the metal atom, called "windows", the different kinds of cold fusion reactions can occur as the invading train rebounds from the Coulomb force of the metal atom's nucleus. For example, a type of intermediate neutron is proposed to form in "window II" (in a Pd or Ni atom, the inner electron cloud) when a proton or deuteron weakly captures an inner-shell electron of the metal, forming an "unstable mono - or di - neutron" (UMN, UDN), respectively:

(a) $p + e^- + E \rightarrow n^* + \text{neutrino}$

(b) $d + e^- + E \rightarrow {}^2n^* + \text{neutrino}$

The E-value in reactions (a) and (b) was assigned an arbitrary val-ue of 30 - 35 KeV (expected to range in the 10's of KeV). Both neutral particles (UMN, UDN) are useful to carry out various transmutations in cold fusion cells. In solid - state CF experiments, metal transmutations can be abundant when the flux of UMNs or UDNs is high. In cavitation methods (including SL), transmutations are also predicted because the compressed bubble wall that surrounds the energetic plasma-like proton chains acts like a metal-atom barrier in solid-state methods.

It is suggested that oxygen, argon or nitrogen atoms may interact with proton chains that are invading the bubble wall. Capture of an inner-shell electron by the invading proton, as in reaction (a) above, will result in photon emissions during quantum energy shifts. Nitrogen will emit a photon of blue light [1], and perhaps reaction (a) is a source of this emission.

Reaction (b) is another possible cause of the emissions. Deuterons can sometimes form when, on occasion, two protons in a chain fuse with an orbital electron inside the invaded atom's electron cloud: p + e- + p = d + neutrino + 1.442 MeV. This fusion also would contribute to the emission bursts in SL.

Instead of sonoluminescence being a "frontal attack" that magnifies sound into light, it may be regarded as a kind of "back door invasion" that steals inner electrons, allowing higher electrons to fall down the quantum stairs, thus emitting photons of visible, UV and sometimes soft X - rays.

In addition to the visible light, bursts of ultraviolet radiation are measured, and Dr. Putterman and others suspect that soft X - rays are also produced in SL experiments [4,6]. Electron capture in the above reactions could also account for the UV and soft X-rays emitted by the various "invaded atoms" (e.g. oxygen, nitrogen, argon) in the bubble wall. The same mechanism could generate the spectra seen when SL experiments are doped with elements like the inert gases (see below).

What about the flash width of 50 picoseconds measured in SL experiments? A vortex of plasma proton chains that suddenly forms in a squeezed bubble would, it seems, maintain the reactive state (capable of invading the bubble wall) for only about 50 picoseconds while propelling the proton chains into the bubble wall within at least one-fourth cycle of an oscillation of the chains (representing maximum amplitude or displacement). Dr. David Deak, a physicist in New York City, has noted that

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during bubble collapse "the implosion velocity exceeds Mach-1 relative to the gas. Mach-1 is reached about 10 ns (nanoseconds) before R_c ; (R_c = the collapse radius.)" [5].

It is hypothesized in this model that, at the 10-ns instant before minimum radius, a shock wave is generated and begins to advance ahead of the imploding bubble wall, quickly slamming into the center to create a very high temperature and pressure [2,6]. Subsequently, the effects of the shock wave are amplified even more as it bounces back out from the center. Now the swirling plasma is completely formed and is carried radially outward from the center by the rebounding shock wave where it encounters the inward approaching bubble wall. The proton chains in the plasma can penetrate the bubble surface, causing the described reactions and emissions, during the interval that the maximum (reinforced) amplitude of the oppositely - moving wave fronts remains, namely 50 ps (fig.1). At this instant, the bubble has reached or nearly reached its minimum radius: about 0.5 micron, according to Dr. Putterman [6].

Hypothetically, then, assuming a minimum one-fourth oscillation of the plasma protons during the 50 - picosecond interference time, a complete period would equal a maximum of 200 ps and have a minimum frequency of:

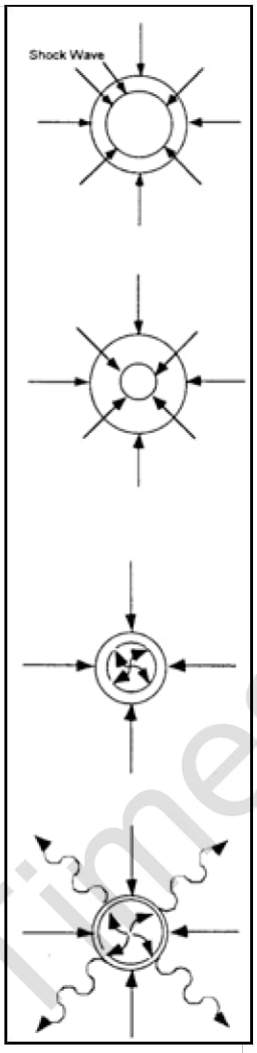
$$f = 1/T = 1/2\times10^{-10}\ \text{sec} = 5 \times 10^{9}\ \text{Hz}$$

If this analysis is valid as an estimation, then a microwave frequency is predicted for the proton plasma inside a compressed cavitation bubble. Perhaps a superimposed microwave input in SL experiments could yield interesting results.

Transmutations in SL?

Is it possible that those tiny bubbles in all the cavitation methods are doing alchemy? A summary report from the Third Russian Conference on Cold Fusion and Nuclear Transmutation (Oct. 1995) announced a surprising and startling discovery by Dr.Yu. N. Bazhutov: the finding of carbon-14 in the solutions used in the YUSMAR vortex cavitation machine of Dr. Yuri S. Potapov (Kishinev, Moldova)[7].

In the hydro-mechanical pumps of Dr. Potapov and also James Griggs (Hydrosonic Pump™), violent agitation and circulation of the water will increase the amount of nitrogen dissolved. (Of course, some nitrogen is present in the water supplies in SL and in the Stringham/George ultrasound fusion.) A nitrogen atom in the collapsed bubble wall, if absorbing a free neutron in the bubble, can undergo the familiar transmutation to carbon-14:



(a) Bubble collapse forms shock wave that accelerates ahead of bubble wall. (After *21st Century Science and Technology*, Vol. 8 No. 2, p 48).

(b) Shock wave slams into center, creating a plasma of high temperature and pressure.

(c) Shock wave bounces back out, carrying swirling vortex (containing protons) toward the still - shrinking bubble wall.

(d) For about 50 picoseconds, out bound proton chains invade the inbound bubble wall, causing reactions that emit the flash of light. The bubble is at minimum radius, about 0.5 microns.

(c) $^{14}_{7}N + ^{1}_{0}n \rightarrow ^{14}_{6}C + ^{1}_{1}H$

The UMN might be the agent to convert N-14 to C-14 inside the bubbles in the YUSMAR device. (By implication, the other cavitation methods could produce carbon - 14, as well. However, proposing this reaction at all assumes that the C-14 reported is above normal background levels produced from natural cosmic neutrons.):

(d) $^{14}N + n^{*} \rightarrow ^{14}C + p$

However, the energy input (E=0.035 MeV) that was estimated in the production of the UMN in reaction (a) is not enough to give a positive Q-Value in reaction (d). Instead, if the E-Value in reaction (a) were about 0.160 MeV, then reaction (d) becomes exothermic (Q=3.7 KeV) and possibly could account for the carbon - 14 in Dr. Potapov's device. Of course, to accomplish this more energetic electron capture by the invading protons in reaction (a), "window II" moves further inside the "barrier" atom being invaded (in this case nitrogen) because E has increased to 160 KeV in making the UMN.

Also at the 3rd RCCFNT Dr. N. Samsonenko presented a paper titled, "Exact Solution of the Barut-Vigier Model of the Hydrogen Atom." The abstract review stated, "Exact solution of an equation with the Vigier Hamiltonian was obtained. Existence of an energy level at 80 KeV was shown and was used to explain CF phenomena,"[7].

One curious speculation is whether the 80-KeV H atom is energetically equivalent to another state of the UMN. Perhaps multiple resonances between proton and electron wave functions are possible, that is, ~160 KeV, 80 KeV and perhaps ~40 KeV energy states of the UMN.

Testing the Theory

One test of this hypothesis of UMN-catalyzed transmutations in cavitation devices would be the addition of a small quantity of ammonia to any of the water supplies of Potapov, Griggs, Putterman et al., or Stringham and George. After operation of the device for a time, collection of the vapors might reveal the presence of radioactive methane:

$$NH_4^{+}(aq) + n^{*} \rightarrow {}^{14}CH_4(g) + p$$

A similar test could be done by adding a halogen to any of the cavitation water supplies. Transmutation to the next noble gas would be supporting evidence for this UMN mechanism. For example, use of bromine in the water might yield krypton:

$$^{81}Br + n^{*} \rightarrow {}^{82}Kr + e^{-} + \text{neutrino}$$

The formation of Kr-82 should be direct (same for Br-79 to Kr-80). If instead the transmutation takes place via neutron capture, then Br-81 converts to Br-82 which then beta decays to Kr-82, with a half life of 35 hours.

One more test might interest some researchers. Perhaps a solution or suspension of bismuth can be prepared for use in a sonoluminescence experiment. If UMNs form in the bubbles and convert Bi-209 to Po-210 by adding the proton, then evaporation of the solution should leave behind a precipitate that contains polonium-210 which can be detected by its alpha - particle decay (5.3 MeV alphas). The half life of this decay is 138.4 days (1.2×10^{7} seconds). Thus, only about 2.5×10^{7} Po-210 atoms need to form to give an average decay rate of one (1) disintegration per second.

Noble Efforts!

Thanks to the exacting work of many researchers who continue probing the mysteries lurking in their bubble machines, sonoluminescence is surfacing as a very fascinating and potentially important practical area of physics. And every bubble helps. For example, experiments conducted at UCLA discovered that the addition of small amounts of a noble gas to SL water will create effects that are amplified and also characteristic of the particular noble gas. Hiller, et al., reported [8]: "Increasing

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the noble gas content of a nitrogen bubble to about 1% dramatically stabilizes the bubble motion and increases the light emission by over an order of magnitude to a value that exceeds the sonoluminescence of either gas alone. [In fact, for maximum effect in un-doped experiments, the dissolved air must contain its normal 1% argon.] The spectrum also strongly depends on the nature of the gas inside the bubble: xenon yields a spectral peak at about 300 nanometers, whereas the helium spectrum is so strongly ultraviolet that its peak is obscured by the cutoff of water."

It is not known by this author whether a xenon-doped SL experiment ever has been found to convert some of the xenon to cesium, as in the following proposed reaction with Xe-132 (27% of natural Xe):

$$^{132}Xe + n^* \rightarrow {}^{133}Cs + e^- + \text{neutrino}$$

If this transmutation is occurring, the attendant quantum energy shifts in xenon atoms during reaction would have to account for the measured emissions (e.g. 300 nm peak). And after a long enough run, chemical analysis might detect the presence of cesium-133.

Final convergence of all the solid-state cold fusion methods and cavitation methods seems likely. Sonoluminescence might one day provide a means to help rid our planet of the long-lasting radioactive waste deposits that continue to accumulate.

Is this wild speculation? Maybe the dream more than "sounds" good. Perhaps it will be do-able!

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Acknowledgment:

The author would like to express appreciation to Dr. Millennium Twain (Menlo Park, CA) and Chuck Bennett (Sacramento, CA) for their contributions to some of the concepts offered in this article.

EXPERIMENTAL EVIDENCE FAVORÎNG BRIGHTSEN'S NUCLEON CLUSTER MODEL

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ABSTRACT

Brightsen's Nucleon Cluster Model (NCM) predicts that a relatively low-energy photon can stimulate a nuclear transmutation under certain specified conditions. Examination of an experiment by Lin & Bockris demonstrates that the transmutation of mercury-201 to gold-l97 induced by a mere exothermic chemical reaction (burning gunpowder) is an actual concrete example of the novel process predicted by the NCM.

INTRODUCTION

Ronald A. Brightsen has already presented considerable evidence [1, 2, 3, 4, 5, 6, 7], both theoretical and experimental, on behalf of the validity of his *Nucleon Cluster Model* (NCM) of the atomic nucleus. Briefly, by painstaking examination of the systematics and periodicities in both (Z,A) plots of the Atomic Number Z (i.e. number of protons, P), versus the Atomic Mass A (i.e. total number of nucleons, including both protons P and neutrons N, so that A = P + N) as well as (Z,N) plots, it is deduced that the nuclei of all beta-stable nuclides are comprised of just 3 basic building blocks: deuterons, tritons, and helium-3 nuclei, which for brevity are referred to as NP, NPN, and PNP clusters.

In this author's opinion, the most striking evidence is presented in Figs. 7, 10, and 12-14 of [4], wherein experimental data for thermal neutron fission of U-235, U-233, Pu-239 and Pu-241 is plotted as percentage fission yield versus Mass A (which ranges from A = 80 to A = 160) in comparison to the 80 predictions from the NCM which are predicted. These are complicated double-hill, triple-valley shaped curves, and the *virtually identical agreement* between the NCM predictions and the experimental data (which in most cases is uncertain by up to ten to twenty percent) is truly stunning. In this author's opinion, Nobel Prizes have been awarded for comparable achievements which are not even as conclusively overwhelming, regarding agreement between theory and measurement, as in this case: noting that the experimental data are not perfect, the cited Figures are consistent with the assumption that the NCM is perfect and that the measured data agree perfectly (within experimental error) Reference 14) is one of the relatively few cases wherein world-class scientific information has been published in the patent literature prior to its appearance in one of the archive journals.

The NCM, in contrast to the more often considered nuclear shell models based upon Quantum Mechanics (QM) and sub-nucleon models based upon Quantum Chromo-Dynamics (QCD), postulates that aggregates of any or all of the 3 fundamental clusters are present in the nucleus with their own separate quantized properties, such as energy levels, spin, magnetic moment, etc. Accordingly each *isotope* has *many* separate modes of existence, e.g. at different energy levels for each of the 3 basic clusters, which it is proposed herein to call the isotope's *isodynes*. In Brightsen's opinion, the observed statistical distributions of the properties of nuclides can be better explained by postulating actually physically distinct existence of each possible isodyne in a multi-isodyne population, as the result of which statistical predictions would be the result of ontologically real *population distributions* rather than being considered, as at present, as merely fictitious probabilistic QM calculations, acausally descriptive but not plausibly explanatory, such as are involved in the well-known Gamow theory of alpha emission decay (which in the NCM would consist of decay by emission of a nucleus of a helium-4 consisting of two NP clusters each of which could have its own distinct energy level, spin, magnetic moment, etc.]). The present author suggests that this idea is sufficiently meritorious to warrant further investigation.

Among the novel technical processes disclosed in the cited NCM-based patent application [4] is a procedure for artificially inducing fission of dangerous radioactive nuclei in order to produce stable, less hazardous elements If externally-produced electromagnetic radiation happens to resonate with the magnetic moment of a particular sub-nuclear nucleon cluster, then such a cluster can be excited (independently of other clusters in the target nucleus) to the point where it will jump out of the nucleus, leading to the subsequent transmutation of the nucleus via fission and/or further decay into one or more daughter products of smaller atomic mass and greater natural stability against radioactive decay. The purpose of this note is to call attention to published experimental data which favors the reality of this patent-pending process invented by Brightsen el al. [4].

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ANALYSIS

In 1992, Lin & Bockris [8] experimented with heating inorganic mixtures to produce anomalous radioactivity and anomalous apparent transmutations, such as mercury into gold, using alleged medieval alchemical methodology, such as boiling mercurous chloride (Hg_2Cl_2) in gunpowder (C, KNO_3, S). During two such "burns" of gunpowder, anomalous beta radioactivity having half-lives of 17.7 hours and about 20 hours, respectively [average 18.9 hours] was measured.

A careful examination of the various half-lives $t_{1/2}$ of possible reaction products leads to a limited number of possibilities, all of which proceed from stable isotopes of Hg, involving triton t = $_1H^3$, alpha α = $_2He^4$, or deuteron d = $_2H^1$ emission and either electron (β^-) or positron (β^+) emission, or electron capture (E.C.), or isomeric transition (I.T.) in which X superscript^m refers to a meta-stable nuclide:

1. $_{80}Hg^{196}(\gamma,t)_{79}Au^{193} \rightarrow$ [E.C., $t_{1/2}$ = 17.5 hrs] $\rightarrow$ $_{78}Pt^{193} \rightarrow$ [E.C./β^+] $\rightarrow$ $_{77}Ir^{193}$ (stable)

2. $_{80}Hg^{201}(\gamma,\alpha)_{78}Pt^{197} \rightarrow$ [β^-, $t_{1/2}$ = 18.3 hrs] $\rightarrow$ $_{79}Au^{197}$ (stable)

3. $_{80}Hg^{202}(\gamma,d)_{79}Au^{200m} \rightarrow$ [84%β^-, $t_{1/2}$ = 18.9 hrs] $\rightarrow$ $_{80}Hg^{200}$ (stable)

All other possible radioactive products are either too short-lived or too long-lived to be consistent with the measured half-lives.

However, both $_{80}Hg^{196}$ and $_{80}Hg^{202}$ would have zero spin and zero magnetic moment. Since it is specified in the patent-pending process [4] that there must be a resonance between the incident photons (γ) and a subnuclear magnetic moment, it is clear that $_{79}Au^{193}$ and $_{79}Au^{200m}$ can be ruled out. Thus the measured data support the removal of a pair of NP clusters ($_2He^4$) from Hg, i.e. artificially stimulated alpha-decay via ordinary thermochemical heat containing in its spectrum radiation of the precisely required type.

It is interesting to note that the (NP + NPN) + (PNP) formula shown in the **Atomic and Nuclear Periodic Table of Elements and Isotopes [7]** also balances in this context:

$$_{80}Hg^{201} \rightarrow {}_{78}Pt^{197} + {}_2He^4 ,$$

$$(60 + 10) \rightarrow (58 + 10) + (2 + 0) ,$$

$$[(9 + 51) + 10] \rightarrow [(7 + 51) + 10] + [(2 + 0) + 0] .$$

CONCLUSION

No other logically consistent possibilities remaining, no possible conclusion seems consistent with well-established micro-physical interpretation rules other than to deduce that the cited Lin-Bockris experiment empirically demonstrates a particular, but hitherto unsuspected, example of the patent-pending Brightsen process for artificial low-energy stimulation of specific nuclear transmutations.

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Continued from page 57

potential for waste heat utilization at industrial plants and all types of power plants.

In an even later configuration, this more complex invention is expected to be an extremely efficient solid-state cooler. It is designed to open markets for solid-state cooling down to the region of absolute zero.

Cost-effective electricity from low-grade heat is now on the horizon. Development of all three device applications will accelerate as additional capital resources become available.

MPI intends to make a major contribution to solid-state cooling, energy storage, and the practicality of new energy conversion systems that generate electric power from heat.

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like this: Temperature (in Kelvin) of the hot side, minus Temperature of the cold side, divided by the Temperature of the hot side x 100, equals the maximum theoretical efficiency of any heat engine.

The Stirling cycle comes closer to the Carnot ideal cycle than any other. The best Stirling engines can reach 50% of the maximum theoretical value, a very high figure.

The engines used in today's most efficient electric generating plants, modified aircraft turbines running on natural gas and spinning alternators, are advertised as about 63% efficient. Actual efficiency is probably somewhat less, as the figures provided for engine efficiency are frequently quoted as a percentage of the ideal Carnot cycle. Thus, the real (overall) efficiency might be roughly half the figure advertised. Efficiency also falls rapidly at partial power. The alternator utilized will further decrease overall efficiency.

A few energy conversion systems, examples are photovoltaic cells and fuel cells, are not subject to the Carnot heat-engine cycle. The actual conversion efficiency for such systems is identical to the percentage stated in the technical specifications.

One approach MPI has been investigating involves an unusual Stirling engine design. Other mechanical solutions also remain under consideration. However, recent breakthroughs involving solid-state technology make it increasingly likely that variations of such devices will soon have the potential to supersede systems having moving parts. (A Stirling engine that runs on a 10 degree F Delta T. suitable for classroom use, etc., can be purchased for $195 from New Machine Co. 206-827-2927 or fax 206-822-8137).

The inventor of a patented, radically new apparatus, incorporating an array of thermocouples in an unusual loop configuration, claims prototypes have demonstrated 12% efficiency with a propane burner as the source of heat. Remarkably, a paper study indicates that it will also have 12% efficiency with a temperature difference as low as 250 degrees F. MPI calls this device a Ring-TEG™. Production is expected during 1998.

The same device can also be used, in reverse, for cooling and, particularly with a proprietary MPI improvement, is likely to offer an attractive solid-state alternative to mechanical compressors. Electrons are substituted for Freons and other gases.

The device intrinsically generates a magnetic field having the capability to store electricity. When optimized for this application we call it a HOT S-MES. It will compete with today's Superconducting Magnetic Energy Storage "SMES" systems, all of which require cryogenic cooling. This system of energy storage will be particularly economical when powered by waste heat. MPI has begun marketing variations to several large potential strategic partners.

Research by the Company for a United States Air Force Small Business Innovation Research Contract (SBIR) during 1995, indicated that by substituting proprietary new polymer materials we call Ultraconductors™, for one of the conventional materials utilized in the device thermocouples, a dramatic improvement in efficiency might be realized. These unique polymers have excellent resistance to heat flow, while simultaneously exhibiting remarkably high electrical conductivity (100,000 times better than copper or gold).

When these polymers were tested with a solid-state thermoelectric module utilized for cooling, a great improvement was demonstrated in the laboratory.

Further in the future, an entirely different, very compact, design will also utilize the Ultraconductors. Considerably more expensive to develop, this advanced unit could prove to be a highly efficient heat-to-electric transducer. In the opinion of the inventor, the design of the device takes advantage of an approach that it is not subject to the Carnot limit. If it performs as anticipated, it will not only be suitable for low-temperature reactors, but is expected to broaden the market

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(ISSN 1081-6372)

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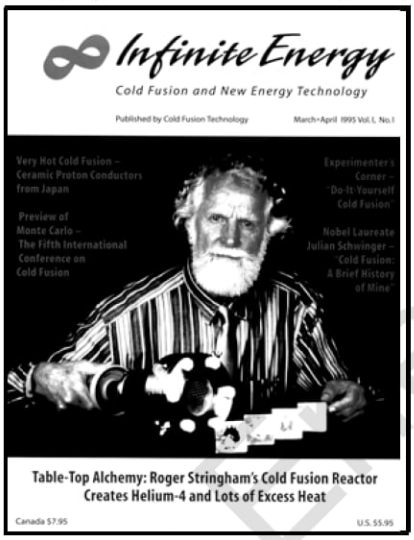

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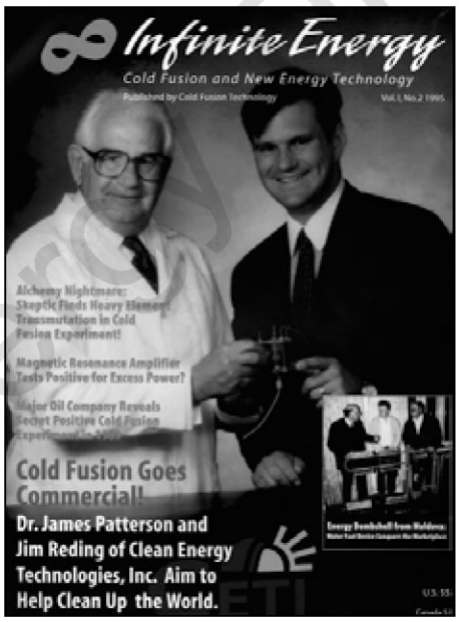

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